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FEBRUARY 1950

BUSINESS · ENGINEERING · INDUSTRY

THE AMERICAN MARKET

What Countries Are Doing To Sell Consumer Goods in U.S. p17

Report to Management

Titanium—Our Next Major Metal p53

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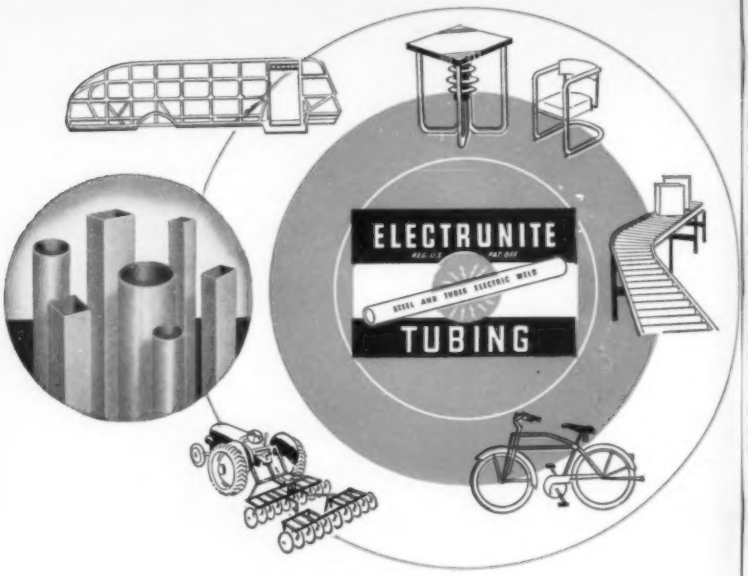

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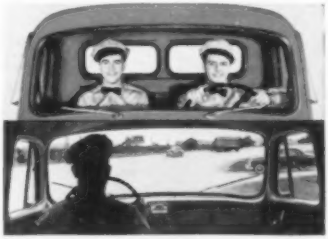

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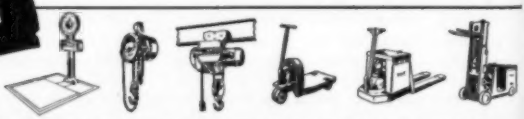

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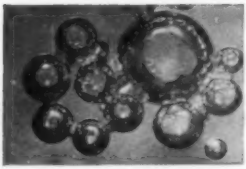

IN THE MINING INDUSTRY THROUGHOUT THE WORLD, the economical treatment of low grade ores is receiving increasing attention. American Cyanamid Company has long pioneered in this field, and today supplies a wide range of chemicals used in cyanidation and also flotation agents used in concentration of many metallic as well as non-metallic minerals. Photo above illustrates principle of the froth flotation method of ore beneficiation: mineral particles, selectively coated by chemical agents, cause the formation of "mineral-bearing bubbles" which rise to the surface and are skimmed off while unwanted minerals sink. Mining is another important industry served by Cyanamid.

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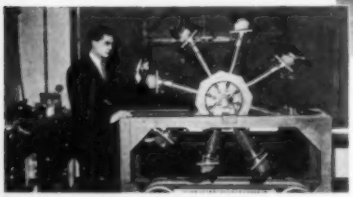

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Business Trends

INDUSTRIAL PRODUCTION is expected to prevail at high level through the first half of 1950. The outlook for the second half of the year is less certain. There may be some slackening of economic activity unless the government revises the taxes or boosts business in other ways. But 1950 nevertheless promises to be another good year for business.

Production of all goods and services (the gross national product) in the first half of 1950 is expected to reach the rate of $260-billion per year, as compared with an estimated $258-billion for 1949. The Federal Reserve Index of Production will probably surpass 177 (1935-1939 = 100), as compared with 172 for the last quarter of 1949 and a low of 166 in October, 1949.

Here are some important factors that will boost the economy:

- The outlook for the construction industry is excellent.
- Steel production is expected to continue on a high level.
- Government spending is rising currently. It will be high enough to insure continuing good business.
- Banking authorities are expected to continue an easy money policy. Purchasing power in the hands of the public will be even higher than in 1949.

There is one danger point on the economic horizon. Business investment will be lower in 1950 than in 1949. This slackening of new investment may slow up business in the second half of the year.

CONSTRUCTION ACTIVITY nearing the 1949 record level is foreseen for 1950. Total new construction in 1949 is estimated at $19,250-million. The Department of Commerce estimates that the same over-all figure will be reached in 1950. The Department is revising its figures to include, among other things, atomic-energy developments and the remodeling of private homes. The revision will boost the construction outlay figure by some $4,000-million.

Thus construction activity alone accounts for about 10% of the gross national product. While construction industries hold up at the present level, there can be no major slump in business.

Some changes in the construction pattern are foreseen for 1950. There will be a notable decline in private industrial construction and, to a lesser extent, farm construction. Public construction, however, will increase markedly.

STEEL PRODUCTION near 90% of capacity level is foreseen for the first half of 1950. The high level of production will be supported by the backlog of orders caused by strikes and a continuing high level of demand for automobiles and other consumer's durables. Automobiles will probably be produced at the rate of 6-million units per year—at least in the first half of the year. But the outlook

Business Trends (Continued)

for machinery is not so strong. Equipment goes hand in hand with new investment, and investment is expected to decline.

BUSINESS PROSPECTS for most other industries range from good to excellent. Here are a few:

Nonferrous mineral prospects are excellent. Copper production is shifting into high gear. Some U. S. producers went to a 6-day work week late in 1949. The increase in production of copper and other non-ferrous metals is in keeping with the general increase in business activity. The industry also is supported by renewed government stockpiling. Copper, for instance, will be stockpiled at the rate of 10,000 tons per month in the first half of the year.

Paper and pulp industries are expected to work at a high rate the first quarter of the year. By the end of this quarter, output may decline 10 to 15%. Production is then likely to stabilize at the new level.

Textile-industry outlook is good, and production is likely to remain at a steady and high level throughout the year.

Agriculture depends on the weather. But farm income is expected to decline about 10%, mainly because of government restrictions on planting. Slightly lower agricultural prices, particularly for meat, will also contribute to the decline.

Planned capital expenditures for 1950 show an over-all decline of 13% from actual expenditures in 1949. This figure is based on a McGraw-Hill survey of all industries. It does not include expenditures of commercial and service businesses. The latter are expected to invest about the same as in 1949—$4,000-million as compared with a probable industrial investment of $12,400-million.

The greatest decline is shown by the railroads, which plan to invest 44% less than in 1949. The automobile industry, on the other hand, will invest more. The chemical and food processing industries, and electric utilities, will invest about the same as in 1949.

Government expenditures are expected to reach a peak in the first half of the year, then level off. Spending will still be large enough to help hold business activity high. No major changes in government fiscal policy are foreseen. But there are good chances for a cut in federal excise taxes. Such a cut would strengthen business and partly offset the expected, decline in investment.

INDUSTRIAL PRICES are expected to remain firm. Downward pressures are counteracted by increases in domestic steel prices. (Export prices for most steel products, however, have been reduced—from 5 to 8% by U. S. Steel Corp.) Automobile prices may decline in the second half of the year if demand slows down. Prices of some basic commodities will decline slightly.

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Washington Report

ECA-BOSS PAUL HOFFMAN is girding for his toughest fight yet to keep ECA free from crippling controls. Even more than last year, some congressmen will try to tie all ECA dollars to specific commodity purchases. Others, disappointed at progress in breaking down Western Europe's trade barriers, will insist that next year's aid be hinged to more definite steps in this direction. Finally, a highly vocal isolationist group will try to cut ECA off without a cent.

Transition from shortages to surpluses in Western Europe means today Europeans are buying less and selling more in the U. S. For example, by the end of last year, the monthly gap between U. S. exports and imports had been whittled to almost half the year-end 1948 rate.

This is one thing the Marshall Plan was supposed to do. But it still hurts congressmen where their votes are. To constituents back home, dwindling exports and increasing competition from foreign products mean less business, fewer jobs, lower profits.

Letters from mid-western oil states, textile-producing New England, metal miners of the Far West, and agricultural interests are already flooding congressmen. They are asking for a guaranteed share of future ECA business. And election years (this is one) sharpen congressmen's ears to such requests.

ECA is the chief target for many congressmen. Hoffman knows this. That is why he is sticking to his schedule by asking for 25% less money in fiscal 1951 than he did in 1950. And that is why the suggested legislation he is sending to Congress to cover ECA's third year does not ask for any major changes.

Anxious not to rile any more special interests than possible, he is not going to tamper with the 50-50 shipping clause; the percentage of U. S. wheat exports that must go as ground flour; restrictions against off-shore purchases of goods declared surplus in the U. S. Instead, he will concentrate on keeping new restrictions to a minimum.

Hoffman is counting heavily on major steps toward economic integration of Europe to force his point across to reluctant congressmen. He knows he stands little chance repeating last year's sales talk—that ECA is a cheaper way to fight the spread of communism than spending billions more for defense at home.

One thing you can count on: If protectionist congressmen get their way and turn ECA into purely a dumping operation, Hoffman and most of his top policy planners will quit. Our guess is it will not go that far—not this year anyhow.

EUROPEAN EXPORTERS may be disappointed in Treasury Department's bill to revise U. S. customs procedures. But Secretary Snyder knows it would be courting trouble to try all at once to undo 160 years' accumulation of red tape. If

Washington Report (Continued)

Congress approves the administration's plan to overhaul customs evaluation procedures this year, that would be the signal to try for further revisions next year. Then simplification of the maze of classifications, which sometimes finds rugs called lace, would be the objective.

INTERNATIONAL TRADE ORGANIZATION is still on President Truman's list of things he wants from Congress this year. Not only does he want it as a realistic statement of U. S. foreign economic policy. He also fears that if Congress fails to pass ITO this time, the whole structure of the Geneva Tariff Agreements may fall apart. Many countries signed the Geneva Pacts only with the provision that the U. S. join ITO. They want the protection of ITO's escape clauses to insure their full employment policies.

State Department has some timely arguments to back up Truman's campaign:

1. ITO is one answer to the growing U. S. farm surplus problem. Commodity pacts like the International Wheat Agreement could be set up in short order for sugar, cotton, other grains.

2. ITO would backstop ECA's efforts to set up regional trade unions in Europe. The Havana Charter details steps necessary to form a customs union.

3. Anti-monopoly provisions of the charter would help deter countries like France and Germany from reconstructing the "old cartel order" in Europe.

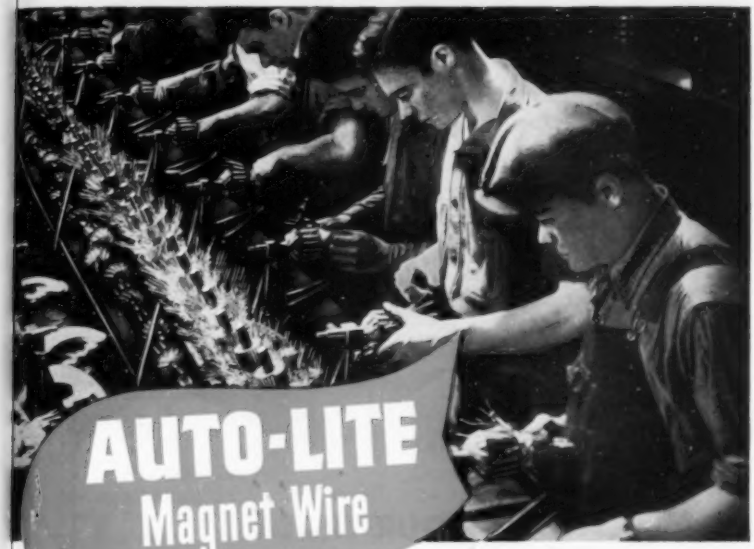
If Congress approves ITO at all, it will be only after a long, bitter debate. Congressmen still dislike the charter's numerous exceptions. The administration will have a hard job convincing them that ITO will have enough coercive power to prevent members from making too much use of escape provisions.

WHO'S GOING TO RUN POINT 4? Republicans favor a new federal agency—call it the Foreign Economic Development Agency—run by businessmen instead of bureaucrats. President Truman wants State Department to take over the job.

This jurisdictional dispute will delay even more the small amount of Point 4 legislation the administration is asking for—the $35-million technical assistance bill and Export-Import Bank authorization to guarantee private U. S. foreign investments against non-business risks.

U. S. MERCHANT SHIPPING for security reasons will get all the government help it needs to stay healthy. That is Washington policy now, despite President Truman's promise last fall in the American-British-Canadian trade talks to review the U. S. attitude towards a subsidized merchant fleet.

To back up this policy, Congress this year will pass a long-range shipping program, allowing all ship owners special tax concessions, accelerated depreciation, and limited liability and extending construction differential subsidies to tramp operators. More passenger ships and a tramp-operator program are likely.



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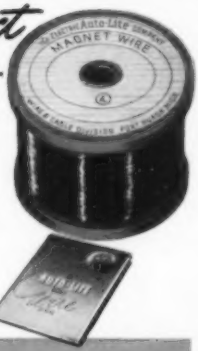

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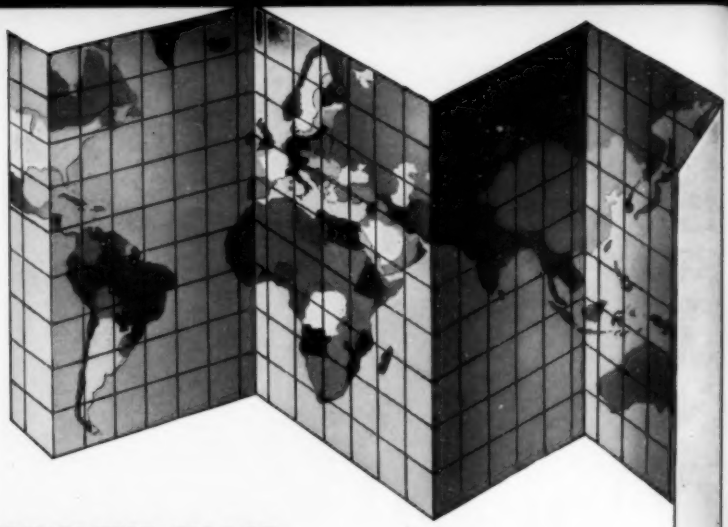

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The American Market

What Countries Are Doing To Sell Consumer Goods in U. S.

THE U. S. CONSUMER MARKET is large. It is a growing market. It is a market that all the world is interested in and wants to sell in.

Last year about $125,000,000,000 was purchased by the American consumer. Part of the purchases were manufactured overseas. This percentage has been growing steadily since the war and can go still higher. But it can be increased only if manufacturers overseas plan products, promote products, and sell products in the American way.

A few months ago, the National Retail Dry Goods Association and the Association of Buying Offices published their report on the consumer goods import market in the United States. Published in cooperation with the Economic Cooperation Administration, the book lists 400 items that the American market will buy from foreign sources. Two conditions for sale are pointed out by the report:

- The landed price of the article must permit a profitable sale of the article.
- Delivery periods quoted by importers must be met.

The bare list of 400 items that the American market can and will buy is not designed to solve the world's dollar problems. It is not enough to guarantee sales in the United States.

Production must be increased overseas, products must be redesigned to conform more nearly to American designs and taste, markets must be studied, and items suitable to that market supplied in quantity sufficient to meet demand. The demand is there.

Many countries—many manufacturers in those countries—are actively engaged in selling in the American market. Others will enter the field.

The following stories are in no way complete as to what is being done overseas to increase exports to the American market. They are examples of plans—plans, in some cases, that are in operation.

Britain Has Made Real Progress Toward Increasing Dollar Trade

Britain's efforts to advance exports to the dollar area have surpassed, probably, the efforts of all other countries. Britain's program was instituted earlier. They have probably shown more and better results than others.

After a recent trip to the United States, Harold Wilson, head of Britain's Board of Trade, stated that British exports to the U. S. could be tripled and these dollar sales could bring the "dollar problem" to within manageable proportions.

Mr. Wilson stressed that there is a market in the U. S. for more than the traditional British exports—Scotch whiskey, fine china, and worsteds. Definite steps have been taken by the British to export new products.

The direction of this effort has been in the hands of Neville Blond. Mr. Blond arrived in the U. S. in May 1948. His job was to develop the American market for British goods. Before his departure in December he had done much to develop that market.

Britain has discovered and developed a merchandising pattern based on the fact that the American market is not one but

British Sweater Maker Swamped by U. S. Orders

Beta, a Manchester, England, raincoat manufacturer, decided it would try American advertising methods to build up a cashmere sweater business in the U. S. With 500 sweaters in stock, the company placed an advertisement in the New York Times Sunday paper. They waited for results.

Those results were overwhelming. From the U. S. came more than 3,000 orders for sweaters, 60% of the orders asking for more than one sweater. And the orders included checks—checks that meant dollars.

Demand passed 7,000 sweaters. Production could not be expanded to meet the demand. Beta, with Government permission, is busy refunding the dollars.

As a result of the first attempt to enter the American market, Beta is reorganizing and being enlarged. It sees a market in the U. S. for men's hosiery, china, leather goods, knitwear, and cutlery.

But when these are offered by advertisement, Beta will have the stock on hand to fill orders.

four markets, distinct in its own style, quality, quantity, taste requirements. Thus, the U. S. has been divided into four selling regions.

Each region is headed by a trade commissioner. The regions: Eastern, with headquarters in New York City; Middle West, headquarters Chicago; Southwest, headquarters New Orleans; Pacific, headquarters San Francisco.

Each trade commissioner is advised by a British businessman. Commissioner will be a civil servant. In addition to the four regional headquarters, the organization will be expanded to include trade representatives in 41 other cities in the United States.

British manufacturers visiting the U. S. to find markets for their manufacturers must first contact the nearest trade representative. Through the representative, the manufacturer will be put in touch with likely customers. After visits, the manufacturer is required by the commission to file a report of his calls, the report to include possibilities of sales, quality, ability to fill orders.

One problem facing British manufacturers, and manufacturers in all countries selling in the American market, is quantity of production. In most, if not all cases, quantity is insufficient. In Britain, and again in all countries interested in the American market, it will be necessary immediately to allocate the necessary dollars for purchases of productive machinery and equipment to permit manufacturers to meet U. S. demand.

Another problem facing the British manufacturer is delivery dates. British exporters are finding it hard to meet the dates of delivery asked by the U. S. importers. Even approximate delivery dates are uncertain. Mr. Blond believes that to better delivery dates, it will be necessary to warehouse goods in U. S.

Warehousing May Be Provided

The office is studying the advisability of such a procedure. Warehousing probably would be on a consignment basis with unsold merchandise being returned to the manufacturer. Costs of such warehousing would probably be borne by the British Government.

Another vital factor in selling in the American market is to tell Americans what you have and to have what Americans want. To do both, the British have established the British Dollar Exports Board to promote these sales.

The British Dollar Exports Board does not give to devaluation all the credit of increased exports to dollar areas. They know much of it is due to the planning and promotive efforts of the Board.

Recognizing early that advertising and marketing were important factors in increasing sales in the U. S., aggressive promotors in the British government have set up an advisory committee to tutor manufacturers in these basic sell-

ing procedures. The Government will subsidize the cost of initial market surveys, promotive efforts, and even minor warehousing of products to start British manufacturers in developing these new U. S. markets.

Gain in Dutch Exports Steady; Need to Broaden List of Items

Only a relatively small number of Dutch products have found a steady market in the United States since the war. These have been, primarily, those products that had good sales-volume before the war—bulbs, seeds, fish, cocoa.

Current emphasis is to expand the number of items exported to the U. S. This trend is indicated by gains made in exports to the U. S. since 1945. In that year $5-million was exported to the U. S. In '46 the figure was $23-million; in '47 it was $26-million; in '48 it was $44-million. The 1949 total is expected to exceed 1948 by about $10-million.

Plans, developed this fall by The Netherlands Minister of Economic Affairs, are designed to bring this steady increase in exports to the U. S. to a quick peak. To augment the Dutch drive for dollar exports, the Government has formed a department of export promotion and has sent a chief trade commissioner to the U. S. The latter's job will be to set up regional trade commissioners in various cities in the U. S.

It will be the job of the regional commissioners to study markets and promote the sale of Dutch products.

Under the guidance of The Netherlands Chamber of Commerce in the U. S., the over-all program will be coordinated. The Chamber plans large-scale exhibits of Dutch manufactures in leading Atlantic Coast department stores early this year. Later this program will be extended west. The Chamber will conduct the advertising campaigns for Dutch products in the U. S. press.

To spur entrance of Dutch exporters into the U. S. market, the Ministry of Economic Affairs has granted permission for Dutch exporters to retain 10% of their net dollars for purchases within the U. S. Previously 100% of the dollars obtained from U. S. sales were held by The Netherlands Bank and the exporter was paid in guilders.

The 10% retained by the manufacturer may be used at his discretion for market research, advertisement, for travel within the U. S., and importation of articles from the U. S.

By this extra effort, The Netherlands hopes that exports to the U. S. will ultimately reach $75-million. Continuation of the program should then keep exports at that figure.

Advertising campaigns within the U. S. will be institutional in nature and devoted to a particular branch of Dutch industry. Individual manufacturers will be encouraged to participate in "tie-in" advertisements.

Expansion in trade commissioners offices will be undertaken with new offices being opened in New York, Chicago, Los Angeles, and Dallas. Space will be taken at the Chicago Trade Fair to display Dutch products.

High Coffee Price Adds Dollars To Brazil, But It's Not Enough

Brazil's dollar position has been improved by recent high price of coffee. But high coffee prices will not eliminate the dollar deficit. Much must be done to relieve the strain. Some headway in that direction is being made.

"Brazil can no longer live on coffee sales alone", states Dr. Torres, Brazilian trade counselor in New York. "We must develop our sales of consumer goods and semi-manufactures, of which we have great stores."

Dr. Torres, well aware of the necessity of expanding dollar sales, finds reluctance on the part of Brazilian manufacturers to take the initiative in exporting to the U. S. They feel tariff barriers are too high to overcome, and Brazil's capac-

ity too small to satisfy demand if it is present.

Torres is pushing expanded U. S. sales from the American end of the line. To assist in building local sales, he has planned touring caravans of Brazilian products. These will be shown throughout the U. S. Currently, goods are being received to fill the trailers. Should the caravan prove successful, Dr. Torres believes the capacity can be reached to fill American needs.

As an additional means of increasing American interest in Brazilian products, a Brazilian commercial association consisting of a half a million members has been formed. The association will open offices in New York City early this year.

Italy Permits Retention of 50% of Dollars Earned By Exporters

Great incentive for exportation to the U. S. is being provided for Italian manufacturers. The Government is permitting manufacturers to retain 50% of the dollars which their shipments earn for purchases within the U. S.

There are restrictions on what the Italian manufacturer may purchase with these dollars. But the incentive program remains the most liberal of all incentive programs among ERP countries.

Purchases must be directly applicable to the industry earning the dollars. For example, a textile manufacturer must spend his dollars in the United States for textile machinery, raw materials, repair parts, and textile supplies. He cannot spend the dollars for luxury goods or for goods not necessary to his industry. If within a period of 90 days the manufacturer has not completed negotiations for the purchase of equipment or supplies, he must, by law, sell his dollars to another Italian manufacturer for lira.

As another approach, or incentive to more normal trade with U. S. the Italian government has lifted export licenses from about 90% of the products.

"We are organizing to arrest this decline and reverse it," says Dr. Clemente Boniver, commercial counselor to the Italian Embassy, Washington. The sharp decline of 1949 exports was in food stuffs —wines, cheeses, olive oil, and tomato products. Gains were made in light machinery, sewing machines, and pottery.

To "arrest this decline and reverse it" the Italian government has organized a special Office for Coordination of Activities in Italy and Abroad. This organization will promote sale of Italian manufactures throughout the dollar area. It also will attempt to minimize the red tape necessary for the importation into the United States of Italian products; increase protection of trademarks and other rights of Italian manufacturers abroad; increase travel of Italian manufacturers within the dollar area to learn better the products wanted, and to understand local promotion, advertising, and marketing methods.

Agency To Conduct Survey

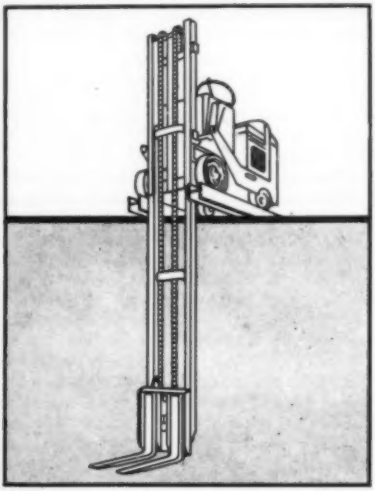
Italian government agencies in the U. S. will continue to conduct market surveys within their own territories. Currently such functions are being conducted by the New York office, but supplementary offices are very soon to be opened in Washington and San Francisco.

Local manufacturers know too little about the American market. For years, the same selling techniques used by Italians to sell in the European market have been used to sell in North America. To improve this knowledge of the American market and to acquaint Americans with Italy's products, Italy will open its first exhibit at the New Orleans International House this spring. The country expects to display at the Chicago Trade Fair in August of this year.

To help you develope sales programs in U. S., we will, on request, recommend sources for marketing studies, permanent and perodic trade exhibits in the U. S., and Canada, and foreign zones.

FOLDING hand trucks can be stored in a 21x15½x9-in. space. Extended, truck is 42 in. high. Truck weighs 25 lb., can carry 700 lb. Platform is 7½x16 in. Flat and curved backs are available from Business Equip. Specialists.—Factory, Dec, p128

Make Your Handling Cheap, Easy



BALCONY materials handling is simplified by this Towmotor Corp. fork-lift truck. Fork can be lowered 98 in. below balcony level. Capacity is 2,000 lb.—Iron Age, Dec 1, p38

FINGERS grab kegs, drums, barrels, or cylinders without pallets or skids. Grab can tier 1 to 6 containers 2, 3, or 4 layers deep. Truck, battery-powered, is made by Yale & Towne Mfg. Co.—Factory, Dec, p134

A COMBINATION flat-bed and fork-lift truck, Lull Mfg. Co.'s Traveloader is adapted for handling and transporting bulky items. Lift extends 72 in. out from beds, moves laterally over them. Load is distributed equally.—Business Wk, Dec 10, p68

How To Cut Costs

Workers and supervisors learn whether they are trained or not. If not properly trained, they learn by doing; they learn from fellow workers; they may learn their jobs improperly. To offset this improper training, management must provide a planned training program for all employees, new and old alike. It is a day-to-day job. The investment in training will later be reflected in higher productivity at lower costs. So you must . . .

Give Employees Good Training

THE SECRET of good training is to be on top of it all the time—know what is being done, how much, how well, by whom and what more should be done. These require a personal survey of the plant, followed by discussions with foremen and supervisors to break the personal survey down further by departments.

Determine Training Needs

General Plant Survey—Formal Training—classroom courses, who attends—is easily determined from plant records. Amount of on-the-job training is more difficult to determine. The supervisor is the source for this information.

Those being taught must be interviewed and their reaction to training must be determined. Departmental and scrap records aid in evaluating the success of previous or current training.

If a wage incentive program is in effect, bonus earnings can be studied. If time-study standards are in use, efficiency records indicate how well trained and interested workers are. Labor turnover, absenteeism, major and minor injuries, grievances help to evaluate success of part training.

Departmental Survey—This survey will determine what type of training your plant needs, both for workers and for supervisors. This survey is not a one-man job, even in small plants. Each foreman must study his department; each supervisor must study the recommendations made by each of his foremen.

The study, properly done, will answer the short-term needs for training. The general survey will answer the long-term questions.

Select the Best Training Method

There are few basic training methods. All have strong and weak points. They can be split into:

Individual Training—In on-the-job instruction, the employee learns while he works. He uses what he learns immediately. Probably the most common type of training, at least 75% is done in this manner. It is fast, interesting, and flexible. No special training facilities are needed beyond the normal production equipment. It is a costly method, in that it takes the time of a fully-trained production man as an instructor.

Off-the-job training takes the form of individual conferences. It is good for putting across key information so that it can be clearly understood . . . induction training and attitude building. It is especially good at the management training level.

Group Instruction—Written material, lectures, and conferences are included in this type of instruction. There is often question as to how much written material is read. So at the lower levels of instruction it is best not to rely too heavily on written material.

Lectures, often thought of as uninteresting, can be highly effective. Good planning, proper execution, and limited groups are controlling factors in their success. This method is cheaper than individual instruction and can cover instruction in a much wider range of subject matter.

Conferences involve smaller groups than lectures and aim for active participation of the audience. They are excellent for developing supervisory skills. Their primary drawback is that they demand excellent leadership.

Combined Instruction—Advantages of on-the-job training are brought together with lecture-laboratory and lecture-shop instruction. Both are good ways to teach complex subjects. Similar to the lecture-shop training is apprentice training, differing only in that production shop training is substituted for a school shop. Of course, formal apprenticeship programs call for class-room hours.

Fix Responsibility for Training

Two rules are good to follow in fixing training responsibility. **Decentralize** training as much as possible. **Centralize** only when you are certain it is impossible for a single supervisor to conduct the work.

Before deciding where the responsibility for the training should rest, the four types of production-workers training must be studied. (1) Basic job-skill training is to bring workers up to minimum standards as fast as possible. For older workers, it is to correct faults in their procedures. (2) Induction training gets the worker off to the right start—it is attitude building. (3) Special-purpose training is aimed at improving knowledge and attitudes in various ways. It covers waste reduction, safety, methods improvement, and the like. (4) Promotional training is to prepare promising workers for higher positions within the company.

It is clear that the foreman cannot be responsible for all these types of training. When instruction is given within his department, it is logical to hold him responsible. That given outside must be shared.

Select, Train Good Instructors

Full-time, professional teachers are the best. But they are expensive. Supervisors are the best, and cheapest, alternative. The instructor must be a master of his field. His general educational background should be above that of his students. He should be a better-than-average conversationalist if lectures and conferences are to be used. Most important of all, he must want to teach.

If part-time instructors are used, they should be plant employees. This tends to keep the instruction on the subject and closer to the trainee's needs.

Provide Good Facilities

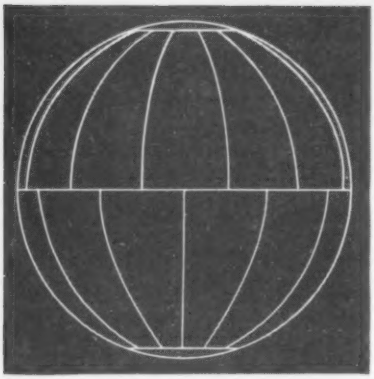
For on-the-job training, facilities are ready-made. Group instruction is not so simple. The meeting place must be comfortable and equipment for note-taking provided. Shabby surroundings are not conducive to good learning. The greatest possible use should be made of training aids—including diagrams, charts, photographs, models, operating equipment, movies and slides, demonstrations, and case studies.

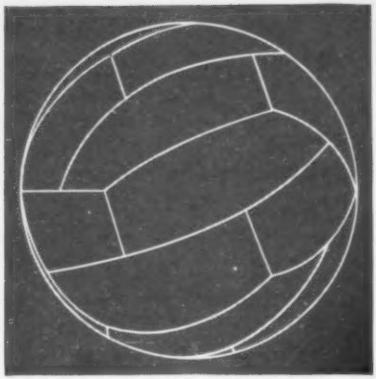
Sell the Training Program

Disinterest is a greater barrier to industrial training's success of a decentralized program than of a centralized one. All personnel within the company must see the need for training and support the program. Make sure everyone understands the objective of the program. Make sure as many as possible have a feeling of participation in the program.—Factory, Dec, p90

How To Cut Costs

In the March issue we will bring you another in the series "How To Cut Costs." It will cover maintenance . . . where, why, and how to spend your maintenance budget.





PLEXIGLAS THINKS TO BUILD 28-FT. STEEL SPHERE

To cut plates for a spherical tank with minimum scrap and welding, Pittsburgh-Des Moines Steel Co. builds an Icosahedron. Each face of the Icosahedron is an equilateral triangle. To determine the exact flat surface which, when curved, would form the sphere, designers turned to Plexiglas and its "memory" factor. A sheet was warmed and formed into a sphere. After it cooled, it was cut into 20 pieces. Then "memory" took place and the curves flattened out, forming flat patterns. Previous "orange peel" sphere construction is shown at left. Icosahedron is shown at right.—Business Wk, Dec 3, p25

New Bottom-Opening Skip

A new bottom-opening skip, developed by G. L. Saunders, Toronto, has many advantages over other standard skips including the Kimberly type. For the same headframe, bucket is longer, bins are taller; a smaller headframe can be used if the foregoing are not required; dumping cycle takes place in last 5–6 ft. of hoist; center of gravity is displaced only 2½ ft. horizontally; delay at dumping position is eliminated.

Drawing or safety head is the same as in the Kimberly type. Two sides nearest bail are extended up beyond bucket top to bearings on suspension shaft, permitting bucket to swing in bail. Dump wheels are near the bottom.

Bottom is one rigid, self-contained unit, hanging from two sides at the back a short distance up from bucket.

As skip is hoisted to dump. Dump wheels enter curved tracks swinging skip end out of shaft. It has to move only a short distance to place bottom on a 45° slope. Bottom closes automatically on lowering.—Eng & Min J, Dec, p96

Supplements RR Car Power

During the 14 hours each day that the Chicago, Rock Island & Pacific's "Rocket" is standing in yards or being turned, axle generators provide no power and yard facilities are not available. To avoid excessive drain on batteries for air-conditioning and lighting facilities during these periods, a Waukeska Enginator has been mounted under observation car.

Providing more power than needed by the observation car, the 25-kw. generator supplements power otherwise supplied by axle generators.—Railway Age, Dec 10, p58

Zirconium Electrodes Give Dazzling Brightness

Light from ¼-in. dia. zirconium electrodes of Western Union's new Telcoarc lamps is one-eighth as bright as the sun. The light is produced as a sharply defined circular spot controllable by stabilizing magnets.

The electrodes are nickel tubes filled with a mixture of 87% zirconuim oxide, 8.7% nickel, and 4.3% iron oxide. The latter two elements serve as binders and electrical conductors when the initial arc is struck. The luminous area in the arc is molten zirconium.

In a 1,000-watt lamp, operating on 55-volt, 18-amp. ac., the source spot has a maximum brightness of 130,000 candles per sq. in. Total light is 20,000 lumens.

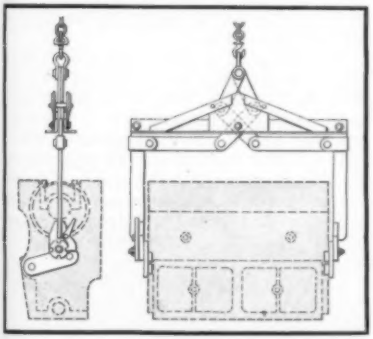
The Telcoarc is expected to find major applications in projection, television, photographic, lithographic, and photocopy industries. It will be of special importance to color photography and ideal for flood and spot lighting. Just one example—with this extra light, 16-mm. projectors can be used with bigger screens for larger audiences.—Prod Eng, Dec, p148

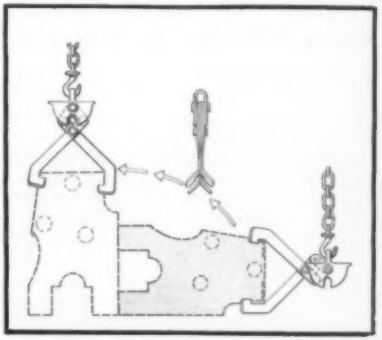
Furnace Bottom in 57 Hours

The record time of 57 hr. was marked up in completing the furnace bottom for the world's largest openhearth furnace. Owned by Weirton Steel Co., the furnace has a 550-ton capacity.

The Ramset (magnesia refractory) hearth was installed by Basic Refractories Inc. Water is added to the Ramset to yield a mixture that compacts readily under the impact of air hammers. The furnace required 178 tons to form a layer 13 in. thick at the taphole and 15 in. thick on the ends.

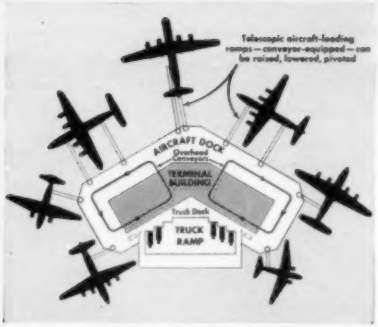
The mixture was carried into the furnace by a bulk conveyor. After ramming, the furnace was dried by firing 12 cars of railroad ties. Two days later the oil burners were lighted and the furnace was heated to 2950° F. to "burn in" the bottom.—Steel, Nov 28, p56





HOOK HANDLERS SIMPLIFY HEAVY LIFTS

Versatility in handling equipment makes shop hoists of even greater value. At left, a turnover grab for Diesel-engine blocks has pivoting end plates with plugs that fit into cored holes in casting. Central links support plates and force plugs into holes. Notched disk allows rotation to four positions. At right, a self-locking grab tilts cylinder blocks. It can be opened only when block is vertical. Slot in shackle plate allows jaws to be spread as pivot pin goes up into it.—Am Mach, Dec 1, p86



TO SPEED PLANE LOADING

Picking up air freight and delivering it and loading and unloading the plane often take longer and cost more than the air trip. This V-shaped cargo terminal is Lockheed Air Terminal, Inc.'s answer to loading and unloading problems. Loading ramps telescope out from terminal at plane-floor level. Inside terminal, endless chain of carts distributes freight, handles both incoming and outgoing cargo. Terminal should handle 80 tons of freight per hr., cost about $250,000.—Business Wk, Dec 17, p25

Buses Sideways on Conveyor

Buses at General Motors Truck & Coach Div. move sideways down an 831-ft. parallel pallet conveyor through painting and fitting departments. Production rose 50% following installation; needed floor space was reduced by the same amount. Hours of labor per coach were cut 40%.

Pallet conveyor picks up coaches directly from the assembly line carrying 53 coaches—33 in painting department and 20 in up-fitting department. Buses are spaced 15 ft. apart on conveyor to provide sufficient working space.

Separate stalls hold coach during painting or baking. Ovens reach 180° in 5 min. after doors are closed. Heat is turned off automatically as door is opened. In up-fitting, overhead conveyor holds power tools, shifts them from one operation to another.—Factory, Dec, p86

New Soviet 5-Year Plan To Get Underway in 1950

Russia's second post-war 5 year plan will probably be started this year—a year ahead of schedule. The plan will cover not only the USSR but all Russian satellite territory from the Iron Curtain to the China Sea. The first point can be deduced from Malenkov's statements in November that 1950 production goals had been surpassed. The second point is borne out in Moscow and satellite press stories.

Linked with the 5-year plan will be a political offensive, designed to oust Tito and bring Yugoslavia back into the Soviet orbit.

The 1950 plan will include:

- Linking of the Silesian industrial area to that of eastern Germany. This will supercede plans to link Silesia with Czechoslovakia.
- Czech industry, including textiles, is to move east from Bohemia to Slovakia.
- Manchurian plants dismantled will be rebuilt to about half their prewar capacity. They will be geared to Russia's—not China's—needs.

The starting, in 1950, of a new 5-year plan does not mean goals of the last plan have been reached. Output probably was as much as 15% in coal, 18% in pig iron, and 20% or more in steel ahead of 1948. Several steel plants were completed in the Ukraine and Siberia. Donets Basin coal output is known to be up. The shift of industry to behind the Urals is shown by the growth in population of industrial centers—up 2- to 3-million.

The claim that the last 5 year plan goals have been exceeded gives the Russians an extra dividend—propaganda both at home and abroad.

Evidence points to this conclusion—basic industry production at the end of 1949 was still short of goals set for 1950. Agriculture and consumer goods have dropped below the 1948 goals.—Business Wk, Dec 10, p101

Where Is Color Television?

Long search for a TV color system has led to three different methods of transmission. Here is what you can look forward to in your home

DEVELOPMENT OF COLOR television has undergone a remarkable reversal in the past 10 years. In 1940 when the color system of Columbia Broadcasting System (CBS) was first demonstrated, operation was on a 6-mc. channel from 50–56 mc.

In 1946, CBS abandoned the 6-mc. channel in favor of a 16-mc. channel from 480–496 mc. In the same year, Radio Corporation of America (RCA) announced its work on a 14-mc. channel. Today, only a few years later, color television is reinstituted on 6-mc. channels.

A third organization, Color Television, Inc. (CTI), has also developed a system for 6 mc. But opinion is not unanimous that a 6-mc. channel will be successful for color television. Du Mont Laboratories strongly opposes the proposals.

The reason for the shift to 6 mc. is not hard to understand. A large portion of the ultra-high frequency region from 475–890 mc. formerly reserved for color television is about to be allocated to black-and-white (monochrome) service because of the pressing public demand for more television stations. So if color television can be made to work on 6-mc. channels, it can be instituted, when ready, on the 6-mc. channels soon to be given over to monochrome telecasting.

An important question is whether owners of black-and-white sets can utilize the 6-mc. color transmissions and at what additional cost. Existing receivers can be converted to either type of reception, but the three systems proposed by CBS, CTI, and RCA differ markedly in the conversion cost.

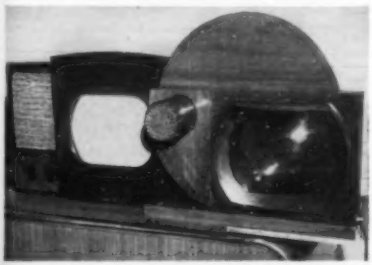
The three systems currently proposed are all of the sequential type; that is, they employ one signal that takes on, in time sequence, the three primary color values inherent in a scene. The systems differ fundamentally in the rate at which the color sequence occurs.

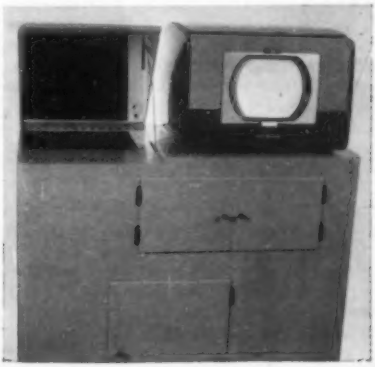
In the CBS system, each field of the scanning pattern is scanned as a whole in one primary color. Fields are scanned in the sequence of red, green, blue. This is called the "field-sequential" system.

Scanning fields are laid down at 144

DIRECT-VIEW converter of RCA system has complicated arrangement of mirrors (right)

COLOR CONVERTER of CBS system is a mechanical disk in front of modified receiver (below)





fields per sec. This rate is slow enough to permit the color sequence to be introduced by positioning in front of a direct-view picture tube a succession of optical filter segments carried on a filter disk rotating at several thousand rpm.

Mechanical Devices Cheaper

The CBS system thus permits use of a mechanical color sequence device. At present, it appears that a mechanical device is cheaper to build than the electronic sequence devices required in the other two systems. The CBS system needs an electronic device for pictures having diagonals greater than 12 in., because such a mechanical disk would be be too large for safe rotation.

In the CTI system, color change is introduced between successive lines in the scanning field, so the system is in the "line-sequential" class. Scanning standards are 525 lines and 60 fields.

The color sequence rate is more than 100 times as great as the CBS rate so no mechanical method of introducing color sequence is possible. In the camera, three separate lens systems, each with a primary color filter, project three identical images of the scene on the mosaic of an image-orthicon tube.

Side-by-Side Images

These images lie side by side and are scanned by the beam of the tube. In the receiver, a similar set of images are formed on the face of the picture tube. Three optical systems project the images in precise register on the viewing screen. Colors are introduced by phosphors on the picture-tube screen or by filters in the projection systems.

The RCA system also uses 525 lines and 60 fields, the objective being to permit color transmissions to be viewed in monochrome on existing receivers without modification. Color change is introduced between successive picture elements. A series of dots in the primary colors appears along each scanning line, so system is the "dot-sequential" type.

The camera consists of three separate image-orthicons with lens systems and optical filters. The tubes provide three complete signals corresponding to the three primary color values of the scene.

By means of filters, adders, and sampler (electronic switch), tube output finally becomes a 3.8-mc. sine wave, which with mixed-high signal and sync pulses is the composite video signal.

At the receiver, another sampler produces short color pulses from the signal and sends them to three amplifiers for conversion to 3.8-mc. sine waves. Each sine wave is applied to a separate picture tube, whose phosphor produces a primary color. Color images are combined by projection or by three dichroic mirrors for direct viewing.

Systems Compared

Of the three systems, the CBS system is simplest from the apparatus standpoint, but has restrictions imposed on it by scanning standards adopted to avoid flicker. The RCA system has no such limitations but requires much more complicated, expensive receiving equipment. The CTI system is intermediate in both respects.

The RCA system has higher resolution and freedom from flicker than the CBS and greater freedom from interline effects and flicker than the CTI. The RCA and CTI systems are alike in that they can operate existing receivers without change. The RCA registration problem is greater than in the CTI system, while CBS, using only one tube, has no registration problem at all.

Choice Up to FCC

The choice between the systems, which now are under discussion by the U. S. Federal Communications Commission, appears to devolve on the relative importance placed on scanning limitations and apparatus complexity. The good points of the different systems might even be combined to give still better color reception.—Electronics, Dec, p66

South American Mill Makes Paper from Bleached Straw

An ultramodern paper mill has been put into operation in Montevideo, Uruguay, by Fabrica Nacional de Papel. Designed by an American firm, the Sandy Hill Iron and Brass Works, the mill is one of the world's largest producers of fine paper from bleached straw.

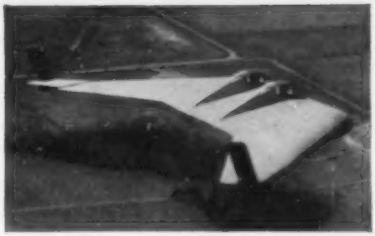
The entire system is automatically controlled. Various kinds of pulp are fed to a 10-ft. dia. Dilts Hydrapulper. When sufficiently pulped, the stock is pumped to one of two holding chests. One chest is for kraft or sulphite stock, the other for broke or other paper stock. Bleached straw pulp is supplied to heater units in slush form or wet laps.

In the paper-machine room, a Bird rotary screening system and Bird Dirter unit precede a complete Sandy Hill-Bertrams flow control system. The latter features the advantages of recirculation and substitution of the multiple manifold approach method for the conventional mass flow system.

The fourdrinier, a nonremovable shaking type, is designed for a maximum paper speed of 500 ft. and covers a wide range of paper, including straw. A Sandy Hill-Bertrams shake, complete with drive and motors, is part of the fourdrinier arrangement.—Paper Ind & World, Nov, p928

Non-Flammable Laminate

A core of pure aluminum or aluminum alloy surfaced with plastic sheets provides a non-flammable decorative laminate for interior decorating. Developed by Bakelite Ltd., England, the laminate can be made of varying gage cores, but 14-g. and 20-g. have been made standard. Phenolic sheets are 0.02 in. thick. Surface can be in a plain color, wood grain, or pattern finish. Core permits bending, even to small radii.—Mod Plastic, Dec. p92



TEST TAILLESS GLIDER

Flight tests have been completed on this tailless glider designed and built by Canadian National Research Council. U-shaped in plan form and with separated side-by-side cockpits, glider has a 46-ft. wing span and is 18 ft. long. Wing load is 10 lb. per sq. ft. Entirely of wood, skin is thick, molded plywood. Conventional ribs are used. Combined elevators and ailerons are employed. Wing tips rotate to provide a nose-up movement.—Aviation Wk, Dec 12, p16

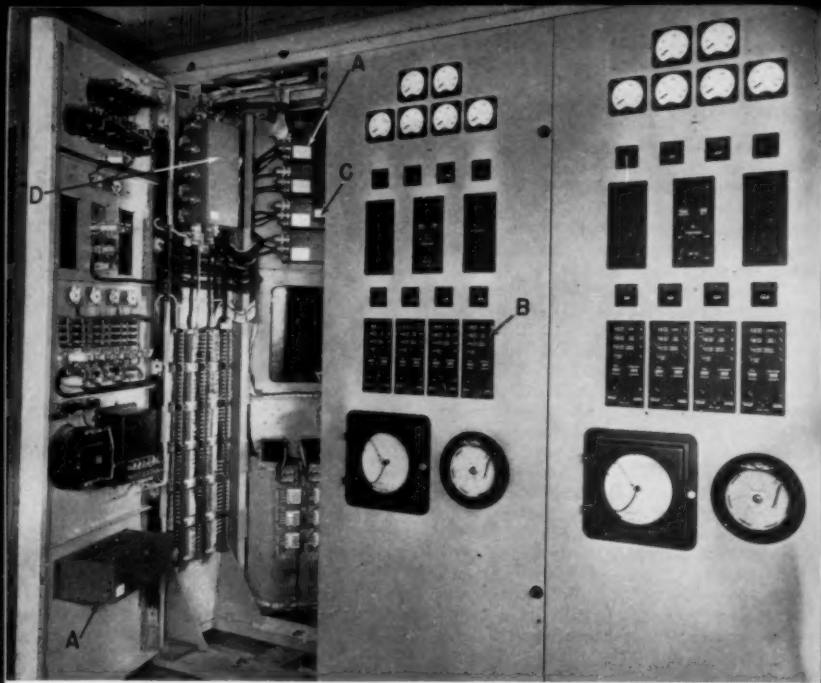
Traces Underground Fire

Progress of one of the largest man-made fires in history is being followed with a General Electric mercury-vapor detector. The fire is at Gorgas Mines, Alabama, where experiments are underway on producing gas by burning a coal vein underground.

At regular intervals through the vein, small capsules of mercury were placed in the path of the fire. When the fire reaches a capsule, mercury is vaporized and detected by the instrument in the gases pouring from the mine.—Power, Dec, p210

Raises Felt-Loom Speed 18%

Speed of felt looms—and eventually of all looms—can be raised 18% by an electronic protection motion developed by Compton & Knowles Loom Works. Harsh bank-offs and high stresses in associated parts are eliminated. Picking is easier, checking more positive.—Textile World, Dec, p149



HALF THE SPACE normally required is ample for this switchboard which features . . .

Switchboard Unitized Control

New approach to substation switchboard design saves 50% in floor space with no increase in switchboard cost and yet improves operation

REDUCTION of feeder breaker operation by 35%, switchboards requiring less than half the conventional space, and automatically varying breaker reclosing sequence permitting full utilization of coordinated fusing—these are the three advantages from a new control system at Idaho Power Co.

The system takes an entirely different approach to substation switchboard design. Telephone type components are used throughout.

The unitized control system consists of a control unit (A) and panel escutcheon (B) for each feeder, a common function unit (C), and a central distribution unit (D) for each group of feeders supplied from a common bus. Units are connected with multi-conductor cable and aircraft type connectors.

The control unit contains one microswitch synchronous timer and a small group of telephone type relays. It performs all feeder control functions. In

case of trouble, the whole control unit can be replaced in less than 10 min.

Electrically isolated tripping and closing contacts for the circuit breaker are supplied by this control unit. Isolation of breaker and control permits use of a switchyard power bus without any danger of feedback complications.

The control also provides transient suppression, which by actual field test results in over 35% reduction of feeder breaker operation. This suppression is accomplished by a 13-cycle delay between operation of the instantaneous relays and the tripping of the breaker. The operating sequence of the reclosing control changes automatically to cope with almost unlimited fault conditions. It is particularly adapted to coordinated fuse protected feeders.

The control escutcheon mounts a single three-position control key, indicating lights, and two counters. All control functions for each feeder are selected by one control key.

Each common function unit serves one entire bus section. It provides transfer of lamp circuits to the emergency power source, supervision of control power, transfer of backup protection, and coordination with other bus sections during sectionalizing or paralleling.

The central distribution unit, also one per bus section, serves as a junction box. It provides all interconnection between unit components and terminal blocks.

Unitized control saves 50% in switchboard space and costs no more. It thus reduces size and cost of control buildings. Space saving is realized even though the switchboard includes local service centers, battery chargers, and supervisory control equipment normally mounted separately.—Elec World, Dec 3, p91

Cuts Steel-Analysis Time

Carbon and sulphur analysis of iron and steel by direct combustion can be speeded up greatly by radio-frequency induction heating. Samples can be heated rapidly to temperatures exceeding 3000° F. and melted in 2 or 3 sec. The time for carbon analysis, for example, can be reduced from 10 min. to 2½ min. Another advantage of this method, for which Lindberg Engrg. Co. builds the equipment, is that r-f. heating is always available with only 1-min. preheat time required.—Steel, Dec 12, p92

Yields High-Vitamin Rice

Two new rice-milling machines, made in England, are turning out a grain exceptionally high in vitamin retention. As rice is the staple diet of many Asiatic countries, it is essential that such valuable substances be retained. For this reason, units are already being supplied to Iraq, Netherlands East Indies, and other producing countries.

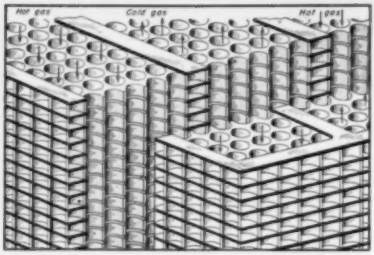
One machine removes the hull of paddy rice without breaking the germ. Rice is fed to a wide rubber belt that carries it under a grooved shelling roller. At one point the grain becomes embedded in the rubber and the lower hull is held momentarily from slipping as the grain is forced through the hull by the roller.

The second machine whitens, or polishes, the rice grains. A specially grooved roller peels the meal off the grain. Degree of polish can be varied as required. Machine capacity is 1,000-1,500 lb. of rice per hr.—Food Ind, Dec, p91

Three-Step Pin-Drafting

A New England worsted mill has replaced its six-step Bradford spinning system with a three-step Warner & Swasey pin-drafting system. Labor costs have been reduced; production per operator-hr. has risen; yarn strength is greater. Necessary subsequent processing is reduced and a loftier yarn results.

In the new system, two operators produce 105 lb. of yarn at a tensile strength of 110-115% compared to five operators producing 31 lb. of 100% tensile strength yarn.—Textile World, Dec, p106



***PERFORATED** aluminum plates and neoprene gaskets dividing unit into hot and cold passages form interior of . . .*

Gas-to-Gas Heat Exchanger

Radically different type of gas-to-gas heat exchanger has been announced by Arthur D. Little, Inc. Its basic idea is to disrupt any laminar gas film that builds up on the exchange surface.

Gas, to be heated or cooled, flows through one of the holes in one of the aluminum plates, then into the space between plates, then through another hole, and so on. The alternate expansion and contraction of the gas stream effectively destroy any laminar film.

The commercial model is 9 ft. high, 3 ft. across, and 7 in. deep. It can handle more than 3,000 lb. of air per hr. The unit, built for an oxygen plant, is actually a double exchanger, having a warm exchanger at bottom and cold at top.

In the bottom part, aluminum plates and neoprene gaskets are alternated with 700 plates in place.

Heat-exchange rate is high. On a test unit in heating and cooling air, a rate of 237 Btu./(hr.) (sq. ft) (deg. F.) was reached.

Other advantages include: (1) easy disassembly and assembly for cleaning or repairing, (2) few metal limitations, (3) minimum longitudinal heat transfer, (4) possible design for any number of streams, and (5) inexpensive to build.—Chem Eng, Dec, p104

Fast Cotton, Synthetic Dyeing Uses Uranium as Catalyst

A photochemical vat-dyeing process, using uranium acetate as a catalyst, is reported to dye synthetic and cotton fabrics much faster than conventional methods. The process is a joint development of Vat-Craft Corp., American Viscose Corp., and Shamrock Textile Processing Co.

Photochemical dyeing is not new. But by using the catalyst and a special machine, speed is greatly increased. Spun rayon fabrics can be run at 125 yd. per min. On two 10-hr. shifts, three or four hands can turn out 150,000 yd. of cloth. Conventional batch methods require up to 75 hands on two shifts to produce 90,000 yd.

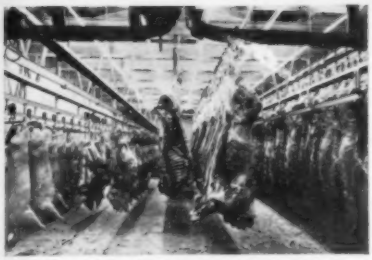
Fabrics is coated with a light-sensitive emulsion. When exposed to light, color is developed. Color is introduced by a suitable dye in the first padding operation. Color development is speeded by use of the catalyst.

Machine consists of four units. In the first, dye and catalyst are applied. In second, fabric is sensitized. In third, lights totaling 112,500 watts develop color. Finally, washing removes excess solution, lint, and dirt.

Runs have been made with nylon, Orlon, cotton twill, acetate rayon, faille, rayon gabardine, poplin, acetate-nylon crepes, and silk crepes.—Business Wk, Dec 17, p70

Offset Hitch Plumbs Columns

An ingenious offset hitch permits eccentric main columns to hang plumb from crane hook in lowering column over eyebolts in pedestal. Hitch is a simple pair of iron straps bent to a right angle and welded together by a separator block. Straps straddle web and vertical leg is bolted to column splice plate. Crane hook clevis is pinned through the corner hole. —Cons Meth & Equip, Dec, p102



SLIMLINES LIGHT COLD ROOM

Continuous row slimline lamps provide uniform lighting on meat carcasses to permit inspection by wholesale buyers in cold-storage room. No fixture channel is used. Instead slimline sockets are installed on covers of outlet boxes welded to steel girders. Slimline tubes minimize heat conditions from lighting system.—Elec C&M, Dec, p151

Silver, 95% Pure, Recovered From Parkes Process Crusts

Experiments in vacuum distillation of Parkes Process crusts at Missouri School of Mines and Metallurgy resulted in recovery of 95% pure silver. The new process is one step, as compared to distillation plus cupellation plus recupellation involved in current commercial processes.

Experiments were conducted in a vertical porcelain-tube vacuum retort furnace. Upper portion of tube is heated by electrical resistance coils. Lower end is connected to a vacuum system, consisting of an oil diffusion pump and a mechanical pump in series. A stainless-steel tube holds up charge in furnace. Distilled metals condense in lower portion and are simple to remove.

Advantages of the new process are:

1. Zinc and lead are eliminated in one operation.

2. Relatively low temperatures save fuel—800–850°C. for the new process compared to 1,250°C. for Faber du Faur furnace.

3. Lead and zinc recovered in metallic form can be reused.

4. Noble metal losses are reduced.

5. Zinc recovery is high as no blue powder is formed, no vapor is lost.—Eng & Min J, Dec, p80

Skytyping Speeds up Messages

A new method of skywriting has been devised. Called skytyping, the system uses seven planes instead of one. All planes fly in a straight line and equally spaced from one another.

Pulses of smoke are released from the planes in such order that dotted letters are formed. The whole message is written in the time it takes the planes to fly the length of the message. A 10-letter message 5 miles long is written in 1½ min. at 180 mph.

Smoke emission is electronically synchronized by the center airplane transmitting modulated r-f. timing pulses. Received in the other six planes, the pulses actuate stepping-relay circuits and smoke valves to release an oil-base chemical into the engine exhaust where it burns.—Electronics, Dec, p72

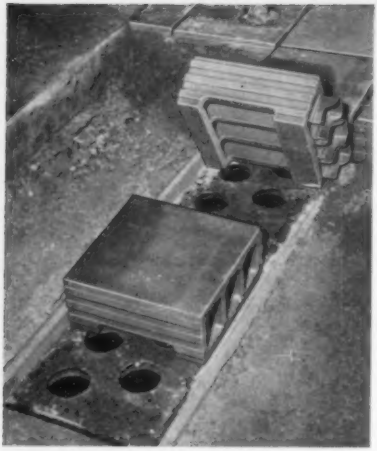
Magnesium Protects Ships

U. S. Maritime Commission will protect its 2,200 reserve cargo ships from corrosion by use of Dow magnesium anodes.

Anodes will be bonded to each hull. Salt water will act as the electrolyte. In the primary cell thus formed, the magnesium bar is the positive pole and the hull the cathode or negative pole.

Current flow generated by the cell raises hull voltage, polarizes hull plates, and thus overcomes localized surface action that causes severe pitting. This cathodic protection will be applied to hull bottom only.

Cost will be one-half that of protection by sandblasting and painting. The estimate to protect a bottom for 1 year is $600, which includes cleaning and painting along waterline.—Steel, Dec 5, p68



***CONNECTION** between perforated ducts and channels is made with open-bottom block*

***TILE BLOCKS**, each having three air channels, are sleeve-fitted and mortared*

Radiant Air Heating System

Warm air can be employed to heat houses with a "closed" type system. No air enters the room, it only circulates in the floor

FORCED WARM-AIR radiant heating system that uses specially designed tile flooring blocks as panels has proved satisfactory in service tests. Called RadianTile panel heating, it was developed by engineers of the Clay Products Association.

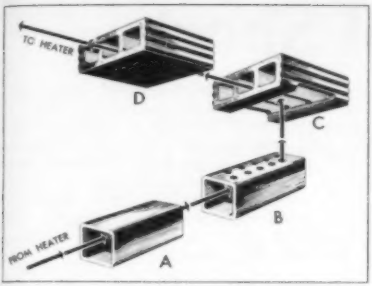
With RadianTile panel heating, the entire floor area of the house is a radiator. Four newly developed items are needed for an installation—two types of floor blocks and two types of clay duct.

Each block has three air channels through it. When laid end to end, blocks are aligned to form continuous channels for the full length of the room. Blocks are laid ⅝ in. apart and mortared. Special sleeves connect the channels between blocks to prevent mortar from entering and blocking the channels.

Forced warm air from the heating unit is carried to the floor ducts through large clay supply ducts laid beneath the floor. The air flows through the block channels and enters return ducts that carry it back to the furnace for reheating and recirculation. The system is "closed," with no air entering the room.

In the supply system, closed-type duct carries heated air to duct perforated on the top. Directly above the perforated duct are open-bottom blocks, which are connected to closed-bottom blocks running the floor length. At the end, open-bottom blocks again connect with perforated duct to return the air to the furnace.

The best floor surface temperature is 90° F., with less than 85° F. not recom-



TYPES of ducts and blocks: closed duct A, perforated duct B, open-bottom tile block C, and closed-bottom block D

mended. Four heat losses are of importance: (1) to the ground by direct heat flow downward, (2) through the masonry at floor edges to ground and outside air, (3) through walls and ceilings, and (4) by air leakage from the house.

The first three can be limited by insulating materials—lightweight concrete and other structural insulating materials under the floor and around the edges of the floor.

Installation of RadianTile system is simple. Supply and return ducts are laid in trenches. Their top surface should be about 6 in. below the desired floor level. Each duct block is 1 ft. square. Joints between sections should be sealed with building paper cemented to the duct with an asphalt compound.

After the ducts have been laid and joints sealed, a sand backfill must be tamped firmly around them to provide a uniform foundation.

A concrete slab is laid flush with top surfaces of the ducts. Tile block are laid in mortar on the concrete. As the blocks have a minimum crushing strength of 700 psi. when embedded in mortar on concrete, the whole floor surface can be an unobstructed slab. Partitions and other structural elements are safely supported on the finished floor.—Am Builder, Dec, p112

Hardeners Aid Production of Aluminum-Alloy Castings

Hardeners are now recognized as important in aluminum metallurgy. By hardeners are meant the alloys or combinations of metals that are prepared rich to assist in the addition of various elements.

As a rule, hardeners are combinations of aluminum with high-melting-point metals or elements that do not dissolve readily in the pure state. Thus, the melting point of copper is 1981° F., whereas that of 50% Cu-Al is 1018-1070° F.

Principal use of hardeners in small jobbing foundries is to extend the range of alloys offered. Stocking different alloys would require a large inventory, while alloying the elements directly may be difficult for the foundryman. Using hardeners, however, reduces melting losses and makes supplying of different alloys much easier.

In fact, a considerable number of alloys can be made with only aluminum and three particular hardeners in stock—50% Cu-Al, 50% Si-Al, and 10% Mg-Al. If a foundryman is engaged primarily in producing castings of only one alloy, such as No. 195, he can add hardeners to that alloy to compound other alloys.—Foundry, Dec, p79

Double-Decked Helicopter

The USAF will take delivery of its first H-19 Sikorsky double-decked helicopter this month. Plans are to produce a commercial version of the craft—the S-55.

Resembling the fuselage of the Fairchild C-82 **Packet**, the H-19 has a cargo compartment 6 x 5½ x 10 ft., carrying a 2,800-lb. useful load. Flight deck, for two, is above the cargo deck. Engine placed in the nose takes no space from cargo. Clamshell doors make engine maintenance simple.

Commercial version will carry 12 people.—Aviation Wk, Dec 12,p15

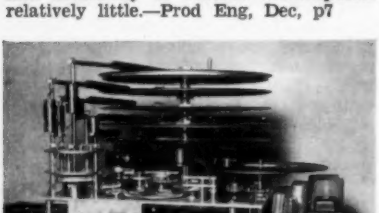
Technical Shorts

Plane Cargo Elevator—Douglas Aircraft Co.'s new "Liftmasters" will be fitted with their own loading unit. Fitted to either front or rear cargo door, elevator has a 4,000-lb. capacity. It operates between cabin floor level and truck-bed height.—Aviation Wk, Dec 12, p28

Charges Oversize Scrap—The world's first openhearth furnace without buckstays takes oversize scrap through its 21-ft. doors. It has made 300 heats successfully. A 70-ton furnace, it averages 8 tons per hr. on all cold charge.—Iron Age, Nov 24, p11

How About Ventilation—In one U. S. plant, storage batteries were located outdoors in completely enclosed wooden hut. Result: an explosion from gases formed during charging. Reason: no ventilating louvers in the walls.—Oper Eng, Nov, p44

Bath Regulates Itself—Self-regulating chromium plating solution needs no chemical analysis for checking plating balance. Also, plating is fast, covering power good, and sensitivity to current interruptions relatively little.—Prod Eng, Dec, p7



TELLS THE TIME

Automatic time announcer gives error-free service. It uses five 16-in., 18-rpm. disk transcriptions to supply 5,760 voice announcements of the time during each 24-hr. period (one every 15 sec.). Between time announcements, recorded advertisements are included from record at right.—Electronics, Dec, p160

Prevents Sugar-cane Tasseling—Tests conducted by Hawaiian sugar-cane growers show that brief periods of light at night prevent tasseling of cane and increases yield up to 1 ton per acre. Planters train 60-in. war-surplus searchlights on fields for a period of 1 min. at about midnight. This brief exposure breaks plant's rest period and prevents flowering or tasseling.—Business Wk, Nov 5, p21

Compressed Blanket Insulation—Kimberly Clark Corp. has developed a method to compress its "Kimsuil" blanket insulation, resulting in a 20% saving in length without settling insulation. Storage and shipping space are reduced; installation time is decreased.—Mod Packaging, Dec, p90

More on Magnesia Pulping—Weyerhaeuser Timber Co.'s magnesia-sulphite pulp mill (see McG-H Digest, Feb '49, p41) is still undergoing development work. Chemical recovery has been only 75% magnesia and 65% sulphur, compared with expected 90-95% and 80%.—Chem Eng, Dec, p74

Mechanical Saw Sharpener—Displayed at the Scottish Industries Exhibition, Glasgow, was a mechanical saw-sharpening machine to handle 6-in. to 6-ft. dia. saws. It can be switched easily from circular to straight saw position. It gullets and top saws at one time and grinds any compound angle.—Cons Meth & Equip, Dec, p65

Mice Like Gum Drops—University of Vermont scientists have discovered that gum drops work better than cheese in mouse traps. The stuff sticks to mouse's teeth, diverting him while trap springs shut on his neck.—Food Ind, Dec, p6

Knockoff Won't Choke Up—Electrical knock-offs on ribbon-lap machines fail to function because lint prevents connection between trigger and electrode roll. Richmond Hosiery Mill has designed a new knock-off to prevent this. A brass pivot roll rides on selvage atop a fifth driving roll. If lap up, run-out, torn selvage, or thin spot occurs, brass roll makes contact with driving roll and lapper stops.—Textile World, Dec, p167

Body Heat Not Wanted—At Societe Genevoise plant in Switzerland, jig-borer scales are generated in concrete room three stories below the ground level. To maintain constant temperature, operator makes setup, then sets a timer so the machine does not begin scribing until 18 hr. after he has left.—Am Mach, Dec 1, p133

Prevents Truck-load Freezing—Available on trucks of 7-ton capacity and larger, a truck-body heating system prevents freezing of the load in winter. Heat is fed to body by a coupler from engine exhaust. Muffler need not be used when system is operative.—Coal Age, Dec, p116

Ultrasonics Control Projector—Slide-film projectors can be remote-controlled by ultrasonics. An atomizer bulb in the lecturer's pocket operates a modified Galton whistle at 25 kc. Microphone picks up signal, which is amplified to operate solenoid in conventional slide changer.—Electronics, Dec, p96

Cleans Cooling Coils—Rock salt, carried by high-velocity air, can successfully remove algae and bacteria from water cooling coils in large power transformers. Important advantage of salt is that it dissolves should coils become clogged during cleaning.—Elec World, Nov 19, p120

Reseeds Forest—Crown Zellerbach Corp. is reforesting a 5,000-acre logged-off area by helicopter. Choice cones are processed and enclosed in seed pellets used in broadcasting. Douglas fir and hemlock predominate in seed cones harvested.—Paper Ind & World, Nov, p935

Speed Affects Banding—Difference in crystal structure, or banding, in centrifugally poured steel castings is caused by wrong rotation speed. This condition was corrected in casting 12-ft. by 12¾-in. gun barrels by increasing speed from 750 rpm. at beginning of pour to 1,250 rpm. in 3¾ min.—Foundry, Dec, p128

Fast Cleaner—Copper shot is now used for blast cleaning and finishing nonferrous parts. It cleans fast and also imparts a lustrous, brilliant, almost burnished finish of natural color to the work. There is practically no plating of copper on the work.—Steel, Nov 28, p55

MACHINE TRIPLES OUTPUT

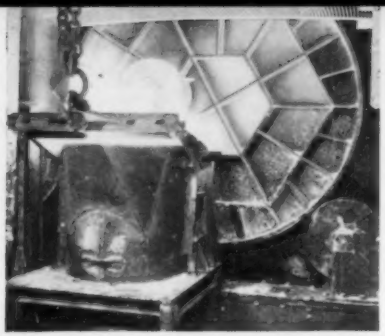
Gas-fired automatic brazing machine at Westinghouse Mansfield Works increased production of Corox electric-water heater elements three times over hand brazing. One operator can braze 120 elements per hr. Machine has 24 fixtures. Table speed and brazing temperature can be varied. Silver-solder preforms are hand placed.—Am Mach, Dec 15, p90

Counts Chickens Before Hatching—Chicken eggs can be checked and counted by a new machine designed by Benz & Helgers, Dusseldorf, Germany. Belt conveyor feeds eggs into machine. They are weighed, counted, and stamped at the rate of 6,000 per hr. Machine was shown at the Frankfort-on-Main fair.—Business Wk, Nov 5, p90

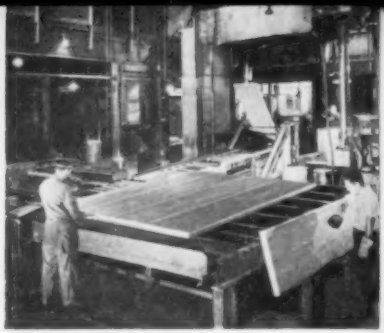
Plastic and Glass—Vinyl-coated cloth woven of Fiberglas yarns is used by Tube Turns, Inc., as curtain material for welding booths. Besides being noncombustible, the cloth is strong, moisture proof, and resistant to mildew.—Weld Eng, Dec, p65

Betters Temperature Control—At Socony-Vacuum Paulsboro refinery, close temperature control is required in lube-oil processing. So all high-temperature lines and equipment are insulated with 85% magnesia and diatomaceous silica, applied singly or in combination, depending on temperature.—Oil & Gas J, Nov 24, p112

Air-cooled Fixture—Flush-type incandescent-lamp fixtures at American Stove Co.'s new administration building are combination lighting fixture and air inlet. Conditioned air passes through fixture housing on its way to office area, thereby cooling the fixtures.—Elec C&M, Nov, p89



BRASS MELTING is done in 10,000-lb.-per-hr. drum-type electric induction furnaces



CONTINUOUS-CAST bars are lowered to roller conveyor and moved to inspection

Modern Continuous Strip Mill

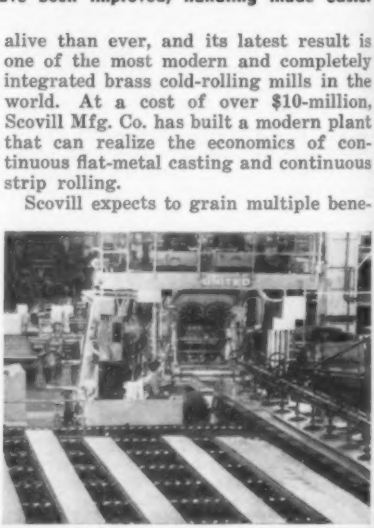
Continuous casting of brass and continuous cold rolling produces better brass. Working conditions have been improved, handling made easier

BRASS TO WATERBURY, Connecticut, has for the last 150 years been a business of romance and daring and progress. The first brass-button mills built up their business against heavy odds by trial-and-error methods and, legend has it, even by smuggling in from England the know-how of plating those buttons.

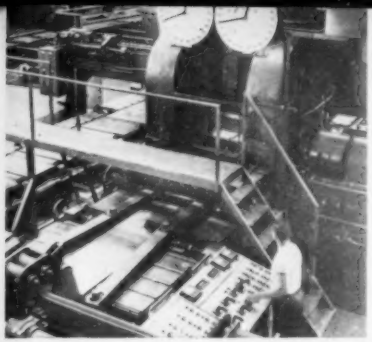
This spirit of bold competition is more alive than ever, and its latest result is one of the most modern and completely integrated brass cold-rolling mills in the world. At a cost of over $10-million, Scovill Mfg. Co. has built a modern plant that can realize the economics of continuous flat-metal casting and continuous strip rolling.

Scovill expects to grain multiple bene-

ANNEALING furnace of roller-hearth type has 33,000-lb.-per-hr. metal capacity



RUNDOWN rolling is done in 4-high cold-rolling mill designed to produce flat strip



BREAKDOWN *rolling in this 2-high mill reduces bar thickness from 2½ to 0.400 in.*

BARS *are handled at several points by overhead beam and rubber vacuum cups*

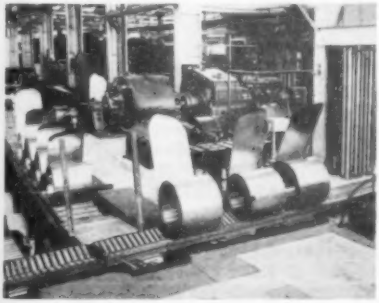
fits from the modernization program. Better working conditions and a minimum of heavy handling are major advantages.

Scovill also is now capable of producing the heaviest continuous-cast coils in the industry, with no welds to pull apart and no imperfect joints to damage dies or tools. Chemical composition, temper, and gage are uniform. Grain size is closely controlled, and minimum tolerance is achieved on thickness, width, length, and edgewise straightness.

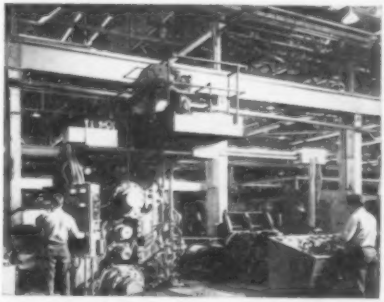
Here is how the new plant operates. Brass is melted in three Ajax-Scomet 1,000-kw. drum-type electric induction furnaces. At staggered 30-min. intervals, each furnace is emptied by transfer ladles into a 9,000-lb. capacity holding furnace mounted over the Junghans-Rossi continuous casting machine.

Metal from the holding furnace, fed to the machine by gravity, enters a water-cooled mold that reciprocates up and down. Here it solidifies and a continuous strip of brass 24 in. wide and 2½ in. thick is carried down from the mold by a set of withdrawing rolls.

A saw hydraulically clamps to the traveling strip and cuts it to 10-ft.



COILS *from upcoiler following rundown are handled by conveyors to protect surface*



FINISH-ROLLING *4-high mill both receives and discharges metal in coil form*

lengths weighing 2,000 lb. A basket then lowers the bars to a roller conveyor. Casting capacity of the machine is 25,000 lb. per hr.

Bars are processed on the new continuous strip mill in roughly these steps: bar corner-milling, two-high roughing, annealing, bar surface-milling, four-high rundown, annealing, pickling and cleaning, four-high finishing, further annealing, pickling and cleaning, inspection, and slitting.

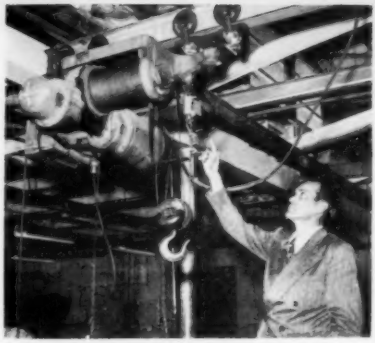
Bars are corner-milled to avoid fishtails during rolling. First rolling is done in a Farrel-Birmingham 2-high, 30x36-in. breakdown mill. This mill, the largest ever built for the nonferrous metals industry, reduces bar thickness from 2½ to 0.400 in.

Handling to and from the mill is done by Wean vacuum-cup pilers, which enable two operators to manipulate the bar on both sides of the mill. The operators also regulate roll speed and gage from two control desks.

After breakdown and subsequent annealing. bars are transferred by specially built Mathews live-roller tables to the four-high rundown mill. Built by United Engrg. & Foundry Co., this mill rolls the bars down to 0.050-in. thickness. A Logan upcoiler coils the brass leaving the mill.

The finishing mill is the same size and design as the rundown mill and handles the same coils as the rundown mill except in lighter gages on the upcoiler. The reel is for metal down to 0.011-in. thick. Handling equipment for this mill differs in that it handles only coils.

Anealing of the brass at various processing stages is done in the three Surface Combustion gas-fired roller-hearth continuous furnaces and one Electric Furnace Co. furnace. The latter has had its over-all length held to a minimum by use of flame impingement in the preheat chamber. Most of the heating is done in this chamber. The long conventional heating chamber then equalizes and brings the bars to the desired annealing temperature.



PREVENTS HOIST OVERLOAD

Safety of hoisting equipment at the Solar Aircraft San Diego plant is increased by preventing overloads to within 5% maximum. Device is a heavy spring in a steel housing on which solenoid is mounted. When maximum load is exceeded, spring compresses and actuates solenoid to open electrical lifting circuit. Only down-travel control circuit can then operate.—Oper Eng, Dec, p51

Trend in Mine Locomotives

A few years ago, coal mine locomotive speed was 8 mph. Now they are 12–15 mph. This approximately 50% increase is reflected in increased output at lower operating costs.

Wheelbases have been lengthened about 2 ft.—to 9 ft., resulting in improved riding and tracking qualities. Coil springs have eliminated all surface except between journal boxes and frame guides. End construction provides more protection for the operator.

Air brakes have made operation at increased speed safer. Traction motors have resulted in balanced design and smaller diameter wheels. Parallel control of motors, instead of series-parallel, permits starting of heavier trips. Slippage of one pair of wheels does not affect starting torque of the other motor. With parallel control, graduated dynamic braking is used.—Coal Age, Dec, p78

Making Chemical Analysis by X-ray Photometry

Industrial mixing processes can be monitored continuously and accurately, without interrupting material flow, by means of X-ray chemical analysis. Applied in the petroleum industry, it enables tetraethyl lead to be blended with raw gasoline in a fixed predetermined ratio.

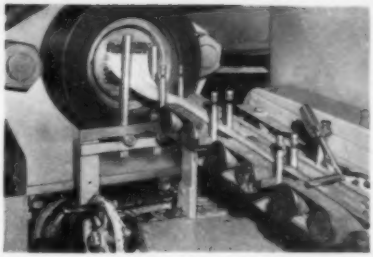
A specimen (solid, liquid, or gas) is placed in the product cell, and a sample of known composition in the reference cell. X-rays are passed through a 30-cps. chopper which divides the rays into two pulsed beams that pass on through the samples. The beam that passes through the reference sample also passes through a calibrated attenuator having a tapered aluminum disk.

Pulsating beams then fall on a fluorescent screen viewed by a phototube. Tube output, consisting of electrical pulses, is amplified. Amplitude of every other pulse is determined by the respective X-ray absorption. Achieving balance by varying attenuator disk thickness indicates difference in concentration. —Electronics, Dec, p87

Yarn-Handling System Saves

Russell Mfg. Co. will save $10,000 a year with the installation of a $6,000 winder-yarn conveyor system between spinning room and winders. Before installation, it took three men on each shift to keep lay up yarn on winder creels. Now one men does it.

System consists of yarn-carrier boxes mounted on a 1,080-ft. track. Track travels 20 fpm. Boxes are loaded on the second floor, each box holding one spinning frame doff of yarn. Boxes move down an incline and pass over winders just below ceiling. Loaded box travels over one winder, makes a turn, and comes back down the creel of the next winder. This is repeated until all winders are covered.—Textile World, Dec, p126



EXTRUDES HARD CANDY

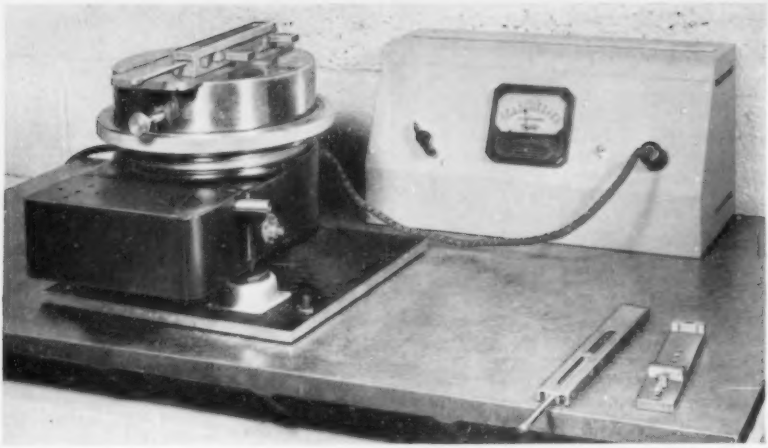
Multiple handlings have been eliminated by this hard-candy extruding machine at S. F. Whiteman & Son. After compounding, cooking, cooling, and aerating, honeycomb candy is forced by hydraulic ram through holes in a steel plate. Strands combine to form the "honeycomb" structure. Extrusion assure more uniform control of size, texture, and porosity.—Food Ind, Dec, p57

Lube Prevents Frozen Joints

To prevent frozen joints in railroad tracks, the Wabash Railroad is applying a graphite grease to all joints. Spaces between joint bars and rails are filled with lubricant, and openings at end of bars are plugged with plaster. If joint bar has to be removed for any reason, lube is applied by hand. If not, it is injected under pressure from a compressor carried on a push car.—Railway Engrg & Maint, Dec, p1177

Steel Prices

Are you interested in steel prices—and other prices? "Business Trends" on p 10 reports that export steel prices on many products have been reduced from 5 to 8% by U. S. Steel Corp., even though domestic prices have been raised about 4%. We'll be glad to send you full information on this important trend.



ELECTRONIC GAGE, specially built, proved capable of making repeat measurements within millionths. Special gage-block clamp is on the gage, two commercial clamps are on the table at the right.

Measure Holes to Millionths

Laboratory procedure, while slow and particular, attains a standard within ±0.000002 in. and transfers dimensions to hole within 0.000008 in.

GROWING APPRECIATION of the advantages of true interchangeability have stimulated competition for refinement in machine tools and measuring instruments.

Straight dowels or pins can be mass-produced to tolerances of 10-millionths of an inch and standard gage blocks as close as 1- or 2-millionths. But finishing odd-sized holes to such tolerances is a far different problem.

Bryant Chucking Grinder Co. has been making progress on this problem of super-precision finishing of odd-sized holes by grinding. The machines and necessary conditions have been described (McG-H Digest, Aug '47, p31), with emphasis on both precision and smoothness.

Recent studies by Bryant have centered on (1) producing a standard measurement of the desired accuracy and (2) transferring that measurement conveniently from standard to hole.

Gage blocks are the core of the metal-working measurement system. Their use as a base reference assures interchangeable parts. But they can be used wrong.

Common belief is that if blocks are wiped and wrung together, stack ends will be parallel and the stack constant in over-all dimension. Failure of available gages to give repeat readings under these conditions were assessed to temperature change or looseness in gage bearings. Errors were persistent.

So the first step was to develop an accurate gage. Bryant engineers made an electronic gage (above) based on reed-

suspended arm carrying a shuttle that interrupts a light beam. A 0.000005-in. movement of contact points is indicated as ½ in. on the scale.

With this gage, or comparator, it was found that gage-block stacks are not consistently true in dimension when assembled in the ordinary way. For example, a fingerprint will give a stack a taper of 4 or 5 millionths inch. Wiping blocks on the heel of the hand is good enough for measuring to ten-thousandths, not to millionths.

For highly accurate measurements, blocks must be clean—washed in 190-proof alcohol and dried with lint-free rag—and then assembled immediately without touching the mating faces.

A second discovery was the inadequacy of common holders. An open-face clamp allows the stack to buckle upward at the middle. A loop clamp of strap steel springs or bends. In either case, repeat readings are not possible.

Bryant developed a clamp having two ribbed sides with all surfaces finished flat and parallel. One is shown mounted on the electronic gage.

Transferring the dimension to the piece being finished in the chuck was solved by another specially built gage. This is a two-point air gage. The two locating points on the yoke keep gage upright, measuring hole diameter instead of a chord. The gage is calibrated so operator can follow hole size up to last few millionths and check for taper at the same time.—Am Mach, Dec 1, p77

Plunge-Grinds Twist Drills

Recent development at the English Steel Corp.'s Manchester works is the simultaneous plunge grinding of shank and body of twist drills.

Two wheels are mounted on the same spindle on a specially equipped Newall LA type grinder. The wheel for the shank is 3 in. wide and that for the body 10 in. wide. Both wheels are 24 in. in dia. and operate at 1,340 fpm. Drill rotates at 136 rpm., maximum size being $\frac{31}{32}$ in. in dia. and 10¾ in. long.

The machine is equipped with a hydraulic work rest, which automatically advances to the work as the wheelhead feeds in. Entire machine operation is automatic after the operator loads and starts the cycle. Floor-to-floor time is 40 sec.—Mach, Dec 10, p1171

Plating Reduces Fatigue Limit

According to U. S. National Bureau of Standards, chromium plating reduces the fatigue limit of steel used in aircraft. On SAE X4130 and 6130, the effect was less pronounced under some conditions than others.

Reduction in fatigue limit increased with increased hardness of the steels. For steel of a given hardness, the fatigue limit decreased with increased temperature of the plating bath.

Three possible causes for the adverse effect of chromium plating are: (1) hydrogen embrittlement, (2) cracks in the chromium, and (3) residual stresses in the chromium.—Iron Age, Nov 24, p82

EASES POLE HANDLING

Dayton Power & Light Co. handles poles safer and quicker with this tractor-trailer crane. It has a telescopic stiff leg extending to 7, 14, and 21 ft. Leg is guided by ⅝-in. steel cable driven through power takeoff from tractor's engine. Load is handled by steel blocks and cable.—Elec World, Dec 3, p120

New Products

Protects Spark-plug Points—An ignition device eliminates "blue points" on spark plugs, caused in cold weather by an abnormal current that forms the blue tungsten oxide deposit on contact points. Unit is placed either between coil and distributor or between ignition switch and coil.—**Electric Auto-Lite Co.**—Bus Trans, Dec, p127

Argon Metal-arc Welding—New argon-shielded metal-arc process maintains arc in a shield of argon between continuous filler metal electrode and aluminum workpiece. Welds have been made on stock of ¼-1½ in. in 2S, 3S, 52S, and 61S alloys. Initial effort is on use with Linde FSM-1 machine.—**Linde Air Products Co.**—Weld Eng, Dec, p44

Diagonal Lapping—Red Wing gear-lapping machine operates on diagonal-lapping principle, which usually requires only two passes and is faster than conventional lapping. It is also said to be capable of correcting gear errors of greater magnitude.—**National Broach & Machine Co.**—Am Mach, Dec 15, p135

Arrests Flames—Safety device combines pressure-vacuum vent with flame arrester that prevents flame propagation into storage tanks containing volatile liquids. Rubber-to-metal sealing prevents valve freezing shut.—**Black, Sivalls & Bryson, Inc.**—Oper Eng, Dec, p68

Milk, Cream Cooler—Small electric cooler has capacity of three 5-gal. or two 10-gal. cans of milk or cream. It is recommended for small farms or to cool cream at larger dairies.—**Westinghouse Electric Corp.**—Elec Whols, Dec, p77

10-ton Rear-dump Truck—Rear-end, off-highway dump truck has a struck capacity of 6.6 cu. yd. and payload capacity of 10 tons. A 125-hp. engine gives it a top speed with capacity load of 35.7 mph. Truck features planetary drive axle, 3-stage double-acting hydraulic hoist, spring mounting for all wheels.—**Euclid Road Machinery Co.**—Cons Meth & Equip, Dec, p109

PACKS CAKE QUICKER, EASIER

Automatic cartoning unit, made by Container Equipment Corp., lowers cost and improves packaging of cakes and pies. Starting at one end with stack of flat cartons, machine sets them up to receive baked goods, glues both ends, seals them, and delivers them to another machine for labeling. Cartons are opened by mechanical arms and spring opener.—Food Ind, Dec, p66

Packaged Substation — Ready-to-install substations for rural systems are available in four basic arrangements. Ratings range from 300-1,500 kva., 22,000-69,000 v. (incoming), and 12,470 Y/7,200 or 13,200/7,620 v. (outgoing).—**General Electric Co.**—Elec West, Nov, p42

Fast Nailer—Portable pneumatic nailing tool nails sheathing or sub-flooring at 40-50 nails per min. Depth of nail set is adjustable. Nail hopper holds 400-600 nails.—**Azor Products Co.**—Am Builder, Dec, p119

Proportional Controller—Device for temperature regulation incorporates proportional control and measures temperature by remote-bulb thermal system. Range is 0-700° F.—**Minneapolis-Honeywell Regulator Co.**—Power, Dec, p152

Never-slip Floor Plate—Abrasive rolled-steel floor plate for floors, platforms, and stairways is claimed never to lose non-slip quality. As surface wears, new abrasive particles are constantly exposed.—**Alan Wood Steel Co.**—Chem Eng, Dec, p150

Brake Lining; Clutch Facing—Wire-Klad reinforced brake lining features flexible wire-mesh reinforcing. It has excellent bonding qualities, high rivet-holding strength and permits deep countersink of rivets. . . . New spiral-wound clutch facing is made of asbestos-metallic yarns. It has low variation in torque under wide range of temperature and load conditions, minimum chatter, improved cushion-clutch action.—**Johns-Manville Corp.**—Eng News-Rec, Dec 8, p134

New Salt Prevents Car Rust—A new salt product that can be used to de-ice streets will not cause rusting of car fenders or underparts. Containing a rust-preventive, called Banox, salt forms a colorless, protective film on metal surfaces.—**Carey Salt Co.**—Business Wk, Dec 3, p64

Controls Mote-knife Angle—New mote-knife gage permits accurate settings, controlling amount of waste at that point on cotton cards. Gage consists of a fitting plate, a scale marked from 0-60°, a small level, and a knurled tightening nut.—**Whitin Machine Works**—Textile World, Dec, p152

Overcurrent Relay—Type IAC-77 provides adequate fault protection for most distribution feeders and picks up loads of automatic devices brought back on the line. It has extremely inverse time characteristic curve.—**General Electric Co.**—Elec World, Dec 3, p132

Core Binder — Liquid, synthetic-resin binder for sand cores (and dry molds) produces water-resistant cores able to withstand high humidity and long layovers in the mold. Binder can be pumped and metered.—**American Cyanamid Co.**—Foundry, Dec, p240

Checks Water Purity—Distilled and deionized water is quickly tested by purity indicator operating on principle that water conductivity is proportional to ion content. Range is 0-30 ppm. of sodium chloride.—**F. J. Stokes Machine Co.**—Food Ind, Nov, p116

Machine Casts Pigs—Foundry pig-casting machine is self-contained and may be moved by crane where needed. It is available from 15 ft. up in multiples of 5 ft.—**William M. Bailey Co.**—Steel, Nov 28, p95

EQUALIZES LADDER LEGS

Interconnected hydraulic units automatically displace oil between legs, as ladders are erected, to correct balance for uneven ground conditions. Ladder can be locked in any position with valve lever. It is made by Anderson Products Co.—Elec World, Nov 19, p148

Chemical Feeder—Compact, self-contained chemical feeder controls, meters, and dispenses reagents and other chemicals into larger stream. Elimination of pumps permits feeder to handle corrosive chemicals. Feeder is transparent plastic, 10x5x2 in. overall. It will treat up to 7,000 gal. per day of water directly.—**Fischer & Porter Co.**—Eng & Min J, Dec, p101

Press Brake—A 48-in. power brake has rated air bending capacity from 48-in. length of 16-gage stock over a ½-in. opening to 24-in. length of 10-gage stock over 1⅛-in. opening. Speed is 20-50 strokes per min.—**Verson Allsteel Press Co.**—Iron Age, Nov 24, p38

Rolls Paint On—Sheepskin-covered paint roller applies paint to smooth surfaces in a stippled finish in one operation. Roller is attached to a 3-gal. tank by a 15-ft. hose. Flow is controlled by valve on roller handle.—**W. R. Brown Corp.**—Ind Dis, Dec, p116

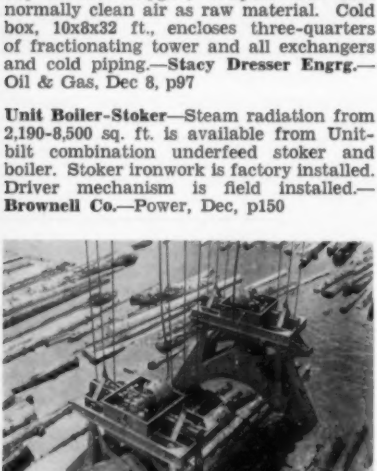
New Products (Cont.)

Stop That Ice—Thermwire heating wire sets will prevent ice and snow formation on shipping platforms, driveways, walks, and signs. Other uses are to de-ice equipment and warm engines for winter starting. Loop is 100 ft. long.—**Thermwire Co.**—Elec World, Dec 3, p138

Grinder Saves Time—A 300% saving in time in grinding 8-in. circular wood saws is possible with Truform contour grinder. Its wheel covers entire saw area to be shallow-tapered. Wheel and saw rotate.—**Thompson Grinder Co.**—Steel, Dec 12, p123

Oxygen Plant—Designed for 10 tons per day of 95% oxygen, compact unit uses normally clean air as raw material. Cold box, 10x8x32 ft., encloses three-quarters of fractionating tower and all exchangers and cold piping.—**Stacy Dresser Engrg.**—Oil & Gas, Dec 8, p97

Unit Boiler-Stoker—Steam radiation from 2,190-8,500 sq. ft. is available from Unitbilt combination underfeed stoker and boiler. Stoker ironwork is factory installed. Driver mechanism is field installed.—**Brownell Co.**—Power, Dec, p150



PICK UP LOG BUNDLES

Giant grapples, hydraulically operated from Berger Engineering Co. bridge crane, pick up huge log bundles at Crown Zellerbach Corp.'s Camas paper mill. Logs are floated to mill in strapped bundles instead of in flat rafts. Grapples can handle 50-ton bundles up to 65 ft. long.—Paper Ind & World, Nov, p940

Automatic Reversing Pumps—Unidirectional delivery, regardless of shaft rotation, is possible with these pumps when installed on machines that reverse—diesel engines, compressors, machine tools. They are designed for pressures up to 100 psi. and capacities of 0.6-11.5 gpm.—**Brown & Sharpe Mfg. Co.**—Prod Eng, Dec, p188

Plastic Welder-sealer—Heating, welding, sealing, and melting of polyethylene, nylon, and polyvinyl chloride are possible with one tool—a flameless, electrical torch. Torch delivers hot air or gas up to 700° F. controlled temperature from 5-40 psi.—**De Bell & Richardson, Inc.**—Mod Plastics, Dec, p130

Shape Cutter—Low-priced, portable oxyacetylene flame-cutting machine, the No. 3 Monograph, cuts steel up to 8 in. thick, in areas of 32x56 in., and at speeds of 3-30 ipm. Machine weight is 110 lb.—**Air Reduction Sales Corp.**—Weld Eng, Dec, p44

Steel Bridge Flooring—Structural-plate steel bridge flooring is designed as replacement for wood-plank flooring. In lengths of 6, 8, 10, and 12 ft., flooring has 2-in. deep trapezoidal corrugated sections and a layup width of 33 in.—**United States Fabricators, Inc.**—Cons Meth & Equip, Dec, p120

Cures Glue—Model R 1-A portable high-frequency wood-bonding machine can reduce fabrication time by as much as 70%. Completely cured bonds are produced within a few seconds on many jobs.—**Pan-American Electronics, Inc.**—Electronics, Dec, p205

Fluorescent Street Lights—Reported to double visible light of mercury street lights and give four times the useable light of incandescents, new fluorescent street lights operate on 110-v. current. Light fans out horizontally, is located at eye level, is a brilliant white.—**W. H. Long Co.**—Eng News-Rec, Dec 15, P78

Louver Lighting—Made as a thin pane of transparent glass, Fota-lite is engrained with white opalescent vanes in criss-cross pattern. It allows direct light to pass through, but blocks light at more than a 45° angle.—**Corning Glass Works**—Elec C&M, Dec, p61

LOW-COAL CONTINUOUS MINER

Designed for operation in 30- to 40-in. coal, Sunnyhill Coal Co.'s small continuous miner (see McG-H Digest, Jan '49, p23) has an overall height of 28 in. with head close. Five chipping heads on bottom row and 10 on top row are expected to give a smooth top without further work. Cut is 9½ ft. wide. Rate of advance is 0-8 fpm.—Coal Age, Dec, p112

Blind Fastener—Known as Bolt-Retaining Speed Clip, new fastener is applicable for blind assembly where tapped accessories are attached to metal panels. Resilient attachment will not craze or chip enamel surfaces.—**Tinnerman Products, Inc.**—Prod Eng, Dec, p178

Cuts Repeating Patterns—Essentially a lathe, the Shapemaster engraver easily and quickly produces designs on cylindrical parts. Four basic elements of engraving unit are master record, change gearing, stroke-adjusting mechanism, and linkage arrangement.—**Monarch Machine Tool Co.**—Am Mach, Dec 1, p134

Locates Defects—Electracer is an electronic tracing device that locates any defective point in wire, cable, or other conductor. By using generated signal and portable probe, defects can be found even if wire is imbedded in a wall.—**Special Products Co.**—Electronics, Dec, p126

For Mobile Equipment—Hydraulic vane pumps, designed for mobile equipment, are made in four capacities from 2 to 11 gpm. There is no starting load because vanes are not extended and pumping does not begin until engine is up to speed.—**Vickers, Inc.**—Prod Eng, Nov, p174

Reinforced Vinyl Sheeting—Cotton fabric tape coated with a wet-backed adhesive reinforces stress points in unsupported vinyl sheeting used for furniture upholstery. Available in 1-, 2-, and 4-in. widths, the tape is moistened with a special solvent and pressed on with a seam roller.—**B. B. Chemical Co.**—Mod Plastics, Dec, p80

Resins Coat Paper—Polythene resins, called Alathon, make paper resistant to chemicals, water, water vapor, and cooking oils and give it toughness and strength. Alathon-coated papers also protect machinery against corrosion.—**E. I. du Pont de Nemours & Co., Inc.**—Paper Ind & World, Nov, p1006

For Quick Analyses—Pocket-size refractometer, designed for fruit and vegetable growers and processors, reads total dissolved solids to 0.1%. On-the-spot inspection determines quality of fruits and vegetables during ripening and of juices and vegetables before or after canning.—**Bausch & Lomb Optical Co.**—Food Ind, Dec, p107

Soldering Machine—New machine has traveling fingers arranged to push parts along a track that passes over an induction heating coil and then through a shallow water trough to set the solder. Capacity is 1,000 pieces per hr.—**Sherman Industrial Electronics Co.**—Iron Age, Dec 8, p36

Incombustible Acoustical Material—Available as tile or boards, a new incombustible acoustical ceiling material can be repainted without affecting acoustical properties. Material will not warp or expand; is applied by adhesive method, clips, or other suspension method. It comes in plain or perforated surface.—**Certain-Teed Products Corp.**—Eng News-Rec, Nov 3, p90

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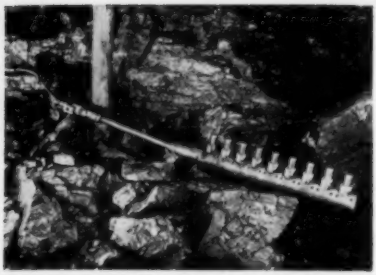
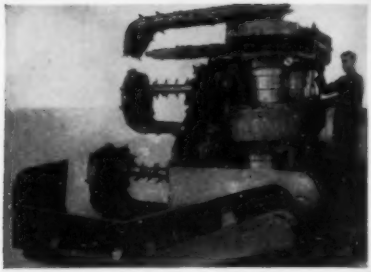


BRITAIN'S "Coalburster" does with water what others do with explosives



RUSSIA'S Makarov cutter-loader is said to have raised man-hour output 50-100%

New Overseas Mining Equipment

Coal-producing countries look to new, better coal-mining equipment as a means to raise production, lower costs. Many machines are unconventional

MINING ENGINEERS and mining-equipment designers in all coal-producing countries are looking for new designs and new equipment to cut coal costs and raise tonnage extracted. This is especially true in Europe. Coal is the starting point for European recovery.

New equipment falls into several categories: cutting and breaking, combination cutter-loaders, coal plow, and tunnel drivers. Most notable development has been centered in England, Germany, and Russia. Little detail is known of Russia's development.

Cutting and Breaking—In Germany, designs have been more unconventional in cutting elements and their combinations than in other countries, with the possible exception of Russia. Machines have been designed using cutter units with double bars, upturned, downturned, and slanting bars, shearers slicing behind face, rectangular and triangular cutting frames.

The Korfman SK-20 universal shearing machine guide frame is suspended on a sliding or threaded spindle for height adjustment. Cutter bar can be rotated for shearing or cutting. Unit is driven by either compressed air or a 9½-kw. motor.

Unconventional cutter bars are used widely in Britain, usually in combination with cutter-loaders. For breaking coal hydraulically at the face, the "Coalburster" (above) has been developed. Holes are drilled the same as for blasting. Stainless-steel bar 2¾ in. dia., chambered to take telescoping piston, is inserted. Pistons are forced forward by water pressure, breaking the face in 25 sec. with only 1¾ pints of water. The slow thrusting action produces larger-sized lumps and eliminates dust.

Cutter-Loaders—Little has been published on the Logan slab cutter introduced in Britain in 1948. It is known that the cutter has worked across a 270-ft. face in a 4½-ft. seam in just under 2 hr. Unit has four cutting elements: a bottom cutter making a 6-in. kerf; a middle or top cutter, making a 3½-in. kerf; a triangular-frame shearing cutter, making a 4½-in. kerf; and a severing cutter, making a 3½-in. kerf. Severer is used only if coal does not fall of its own weight.

The German Eickhoff cutter is de-

signed for fairly thick seams. Basically, it has two horizontal cutting bars followed by a loading element.

In Russia, the Makarov longwall cutter-loader machine is said to have increased per man output by 50–100%. Designed for use in thick seams, the machine is mammoth. Four cutter bars, three bent upward or downward at end for shearing, two rotating shafts for tearing, and a shearing disk comprise the mining elements. Coal is loaded by forward movement of the machine, forcing coal onto a pan.

Coal Plow—Use of this specialized piece of mining equipment is restricted primarily to Germany and Russia. It consists of a vertical cutting edge, which is pulled along a longwall face by rope, peeling off a layer as it advances.

Coal is deflected onto a face conveyor. Plow is usually fitted with cutting edges facing in opposite directions to permit work in either direction. Sizes range from 16–32 in. Blade is usually equal to one-third the seam thickness.

Tunnel Drivers—British mining experts believe it possible to adapt the German Schmidt-Kranz rotary tunneling machine to coal mining. The machine has driven 7.2-ft. dia. tunnels in potash mines, advancing at the rate of 4½ ft. per hr. To be useful in coal mining, where haulage ways are at least 12 ft. wide, the machine would have to be greatly enlarged.—Coal Age, Dec, p70

Odorless Paint Developed

Keystone Paint & Varnish Co. has taken the smell out of paint. The new paint consists of one part pigment, two parts solvent, and one part binder. Heretofore solvent and binder have caused paint odors. Line includes primers, flat, eggshell, and gloss paints; semi-glosses will be added. Paint is recommended for interior rooms, such as hotels, hospitals, theaters, where it is impractical to close during painting.—Business Wk, Dec 12, p66

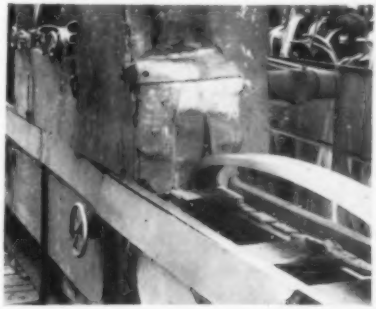
Trend of Power Generation in the Decade Ahead

Improved design of steam plants for operation at temperatures above 1050° F. and correspondingly elevated pressures should figure importantly in power expansion plans.

High-temperature steam turbines at present are considered to be more economical than any other prime mover. In the near future, operating temperature can be raised to 1100° F. and later possibly even 1150° F. This would increase output to about 2,550 kw-hr. per ton of coal.

Equipment manufacturers are pausing at the 1050° F. plateau long enough to gain a background of substantial experience.

Expansion plans certainly should not be delayed because of atomic power possibilities. Although the next 10 years will bring demonstration of power piles,



POWER-BRUSHES BUMPERS

Auto-Lite Sharonville plant reduces production costs and rejects by blending grit marks on cold-rolled-steel bumpers to permit smooth chromium plate. Bumpers are power-brushed in 2,100-rpm. multihead polishing machines. Nine-head rotary machine polishes bumper edges, followed by 12-head inline machine for bumper face and eight tandem machines for curved ends.—Steel, Nov 28, p89

there is slight possibility of piles furnishing heat for the great majority of steam-driven turbines.

Likewise, it is doubtful whether modification of gas turbines for power plant will provide units generally applicable during the next decade.—Elec World, Nov 19, p104

Lard Comeback Promised by New Quality Process

A new top-quality lard—one termed far better than steam-rendered lard—has been developed at Ohio State University. Producing method is a semi-continuous alkali rendering and refining process, plus special bleaching, refining, and deodorizing.

Ground back fat is mixed with 1.75% hot sodium hydroxide and heated in steam-jacketed kettle with agitation. Following digestion, primary separation is made in centrifuges.

Fat is then washed twice, first in 5% brine and next in hot water, and again centrifuged after each washing. Bleaching, deodorizing under vacuum, and plasticizing in a Votator follow.

The product has a delicate yellow color when melted and a white color when plasticized. Uncooked odor is mild. Free fatty-acid content is 0.01%. Keeping quality is said to exceed that of steam-rendered lard by 50%.

Alkali-rendered lard responds to antioxidants, such as NDGA, the gallates, and tocopherols. It retains the excellent plastic properties and chemical characteristics of lard. Bleaching with charcoal is unnecessary. There is no troublesome flavor reversion.—Food Ind, Dec, p53

Hudson Produces Small Car

Slightly smaller in wheelbase and engine than previous six- and eight-cylinder standard, Hudson's "Pacemaker" series is a venture into the lower-priced car field. Wheelbase is 119¾ in. and overall length 201½ in., compared with 124 and 207½ in. in the larger models. The engine output is 112 hp. at 4,000 rpm., compared with 121 and 128 for the others.

Drive is by wet clutch, through the manually - controlled transmission or through the Super-matic transmission to a hypoid rear axle. In automatic phase, gearshift lever is placed and left in high. Up and down shifting is automatic.

"Step down" body design of other models is incorporated. All structural members are one unit, and floor is flush with lower edge of the frame side rail, lowering center of gravity.—Am Auto, Jan, p38

Removes Metals from Foods

New method to refine vinegar employs calcium or sodium phytate to precipitate iron and copper. Their possible effectiveness for the removal of other metals is yet to be determined.

The lower cost of calcium phytate favors its use. One objection to its general use for acid liquid foods is that its commercial form is contaminated with iron. For vinegar, however, a waiting period is possible in which an almost total precipitation of all iron present can be obtained before the vinegar is used.

General application of the phytate method is likely. Other applications for metal removal from food material is under study.—Food Ind, Dec, p50

Air Map Aids Bus Company

Key System Transit Lines finds aerial photomaps of its 128-sq. mi. territory aid in planning future bus service expansion. Territory is shown on sixty-seven 15x10-in. prints. Shifts in population centers, development in new suburban districts, expansion of industry are easily noted in subsequent photos.

Maps take guesswork out of routing studies. Colored tapes trace existing bus routes.—Bus Trans. Dec. p46

Panel Heat Combines With Well-Water Air Conditioning

Aluminum Co. of America's new office building in Davenport, Iowa, (see McG-H Digest, Sept '49, p27) has a split system for heating and air conditioning.

Ceiling-installed radiant heating meets the demand for completely free floor space. The air conditioning is a zone system with all fan rooms in the basement to serve respective zones through main ducts above the corridors.

The air-conditioning system is based on the availability of a comparatively cheap and ample cooling medium—deep-well water at 56° F. The well water teams up with activated alumina to handle building cooling and dehumidification needs.

Incoming air is filtered, then passes over a heating and a well-water cooling coil and into a dehydrator chamber containing the alumina. Result of moisture removal is an increase in the sensible heat of the air. The air splits into two ducts for delivery to building zone fans. One duct has a built-in cooling coil.

Return air from the building zones passes through filters, well-water cooling coil, direct-expansion cooling coil, and a reheat coil. The direct-expansion coil served by compressors is the only need for mechanical refrigeration. Return air is then fed back to zone fans.

After the well-water carries out its cooling function in the coils, it acts as condensing medium for the small compressors. Then it is carried to the roof to flood the roof surface in summertime. —Power, Dec, p112

Chick Eats Less, Weighs More

A chick—a cross between Chinese and Mongolian pheasants and Cornish and New Hampshire poultry—is reported to eat 15-18% less feed to develop each pound of meat. Each bird contains 8-15% more edible meat than other breeds or crosses. It is the result of 10 yr. of breeding by James H. Knowles. He calls this bird Northwester.—Business Wk, Dec 17, p70

Helicopters Help Find Oil

Helicopters in oil exploration are no longer in the stunt stage or for use only under exceptional circumstances. They have proved themselves in practical experience.

In seismic operations, their use can double, and sometimes triple, production as compared to normal ground methods. They assist in laying and towing cables, planting geophones, moving recording equipment and observers into position, and transporting crews, dynamite, and even the shot-hole drilling rig.

Surveying for position location is still somewhat troublesome. In some cases, the station can be located from aerial photographs. Triangulation by surveys on top of wooden towers is still used. Experiments are now underway on development of shoran radar for helicopters.—Oil & Gas J, Dec 8, p79

Carbide Improves Furnace

Gas-producing furnaces can be operated at 2000-3000° F., instead of the usual 1600-1800° F., when silicon-carbide tubes are installed. Results are improved and accelerated gasification of oil, butane, and propane, as well as alteration of the molecular structure of natural gas.

Significance of development lies in the reforming of natural gas to provide a blend suitable for appliance burners designed for water or coke-oven gas.

An experimental three-tube installation produces 24,000 cu. ft. of reformed gas per hr. Operation of the vertical furnace involves introduction of steam-activated feed at top into the carbide tubes. After vaporization, the feed moves down into a catalyst that provides cracking action. Cooling and blending follow. —Prod Eng, Dec, p150

Oil-Well Drilling Tools Are Using More Diamonds

Diamonds are finding new applications in oil-well drilling, in addition to their established uses in bits for coring and hard-formation drilling. Two important new uses are in washover shoes and in whipstocking operations.

Diamond washover shoes are similar to diamond core bits. Their purpose is to recover stuck drill pipe and other such "fish." By drilling formations too hard for conventional washover shoes, they allow fairly quick recovery of fish that otherwise could not be recovered.

In deflecting holes by whipstocking, diamond bits have proved of value. In hard formations, usually the necessary length of pilot hole can be drilled without trouble. Also, there is less tendency for diamond bits to bend back toward the old hole because of reduced resistance of drilling the softer cement plug.

Another application of diamonds has been in reamers used for cleaning and straightening the walls of a hole drilled with a conventional rock bit.

Still another use of diamond bits is in side-wall coring devices. Diamond-set undercutter knives also have been tried, but it is too early to evaluate their performance.—Oil & Gas J, Nov 17, p88

Moves Machines To Jobs

For industries producing many different products, with products changing frequently, a set production line is impractical. Northwest Metal Products, Inc.—making metal items from water pails to floor furnaces—solves its problem by moving presses up to 60-ton rated capacity into temporary production lines to reduce materials handling within the plant.

Heavier machines—presses, shears, press brakes—are not moved. About 100 pieces of machinery within the plant are mobile. They are moved on the average of three or four times a year.

Moving is done by two fork-lift trucks. An overhead crane is available. Overhead outlets every 5 ft. in conduits about 10 ft. apart make setting up of temporary production lines simple. Moves of machinery are made if it is felt the move will save 1 day's work. Moves cost less than $10 and take an average of 45 min. —Factory, Dec, p60

Italy's Chemical Industry

One chief hope in Italy's over-all recovery program is its chemical industry. Italy is now in a good position to help fill the gap left by the virtual elimination of German chemical production.

She has a well-integrated modern industry based on available raw materials. Also she can ship to dollar-short Mediterranean, Near East, and South American markets from which she needs goods in return. Unfavorable factors include high production costs and prices, a burdensome and complex tax system, uneven distribution of domestic raw materials, and shortage of imported raw materials.

Early in 1949, chemical output was 85% of 1938, as against 40% in 1946 and 20% in 1945. Prewar levels are being exceeded in basic chemicals, sulphuric acid, and caustic soda. Fertilizer and insecticide output is about 95% of 1938. Because of raw-material shortage, emphasis is on synthetic products.—Chem Eng, Dec, p120

Lace-Like Plastic Fabric

Developed by Minnesota Mining & Mfg. Co., Lacelon is a lace-like, non-woven cellulose acetate plastic. It may be heat-sealed or formed by direct heat application. It can be combined with paper, cloth, or other acetates by roll casting with a transparent adhesive.

It does not fade in sunlight, wilt in water, run or unravel, and is flame-resistant. It is finding application in women's hats, floral decorations, and gift wrapping.—Mod Plastics, Dec, p93

What Research thinks of Titanium:

"The engineering properties of titanium are outstanding. Only the problem of cost stands in the way of its extensive use as a structural material."—L. W. Eastwood, Battelle Memorial Institute.

What Industry thinks of Titanium:

"Our metallurgists think that titanium has a big future, but that much more development is needed. Like most other new materials or processes, it will slowly find its proper and economic field of application."—John Seastone, Mgr., Materials Engrg. Dept., Westinghouse Electric Corp.

What Government thinks of Titanium:

"At present, money and effort are being applied at a greater rate to the development of titanium and titanium alloys than ever before in the development of a structural material . . . Titanium will have progressed 5 years from now to a degree comparable in significant respects with stainless steel over the past 40 years."—N. E. Promisel, Bureau of Aeronautics, U. S. Navy.

Report to Management

Titanium—Our Next Major Metal

TITANIUM WILL BE our next major structural material. There is little doubt of that. It has an application potential equal to that of stainless steel and perhaps rivaling that of some of the lighter metals.

Why is there such optimism about titanium? There are several good reasons. Titanium is abundant—only aluminum, iron, and magnesium are more plentiful metals. Its corrosion resistance is as good as that of platinum and better than those of nickel, stainless steel, and the cupro-nickel alloys in sea water and in certain other media.

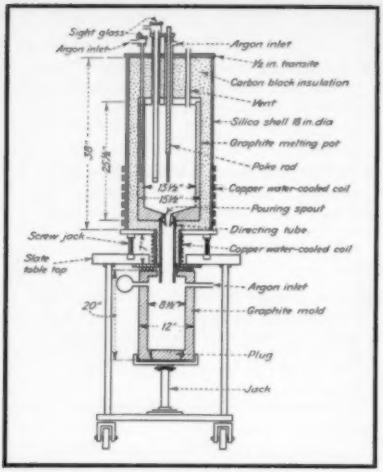
On an equal-strength basis, titanium weighs less than aluminum or stainless steel. Some alloys have tensile strengths up to 190,000 psi. and a density only slightly greater than that of pure titanium.

The metal can be welded, forged, hot worked, and surface hardened. Its hot hardness is high, and both oxidation resistance and creep strength are excellent.

As with other metals, there are disadvantages connected with its use. Machinability is poor. Some alloys have to be worked in the hot state. Present cost is high—$5.00 per lb. of titanium sponge and $7.50 per lb. for 100 lb. ingots. But prices are certain to come down as production rises.

Dr. O. C. Ralston, Chief of Metallurgical Division, U. S. Bureau of Mines, has this to say about cost: "When all the development work is over and the matter becomes one of operation of a plant making 50 tons or more of titanium per day, it is reasonable to expect a production cost of $0.50 per pound, with a price above that for titanium ingot."

Titanium is found in ilmenite ore, which consists essentially of iron oxide and titanium oxide. Mining ilmenite ore is relatively inexpensive. Suction



***INDUCTION FURNACE** used by Du Pont melts titanium sponge in a graphite crucible in the presence of argon*

dredges or power shovels are practical for most deposits.

The ore is refined to the metallic form by batch processing. It is treated with carbon and one of the halogens to form a tetra compound, such as titanium tetrachloride. The compound is then reduced with magnesium, sodium, calcium, lithium, or aluminum.

Titanium Refining Processes

The Kroll process, which employs magnesium, is considered by many engineers to be the most promising for large-scale operation. The equipment consists of an iron reduction pot, or bomb, which has a tight cover and inlets for neutral gas and titanium tetrachloride.

Pure magnesium is heated in the bomb in the presence of helium to 1400°F. The tetrachloride is then added. Titanium is recovered in the form of sponge metal after most of the resulting magnesium chloride is tapped off and the remainder either distilled off under vacuum or leached out with acidulated water.

The Hunter reduction process is similar to the Kroll method, except that sodium is used instead of magnesium. Another process involves decomposition of titanium iodides on a hot filament, but it is slow and expensive.

Sponge titanium is converted to ingot form by powder metallurgy or electric melting. The first method consists in grinding the sponge metal, pressing into compacts, and sintering for 16 hr. at 1750-1850°F. Production of sheets or bars with this method is not adaptable on a commercial basis.

A modified method has been developed by U. S. Bureau of Mines. Titanium powder is placed on a metal sheath and sealed in by welding. Sheath and powder are rolled directly into sheets. Advantages of sheath rolling are:

- It does away with compacting of powder under high pressure (50 tons).
- It eliminates vacuum sintering.
- It permits preparation of almost unlimited masses of metal in a single piece.
- The metal is dense, smooth, ductile, and cold-workable.

Electric melting can be done in either induction or arc furnaces. Induction melting is done either under vacuum or in the presence of argon gas. E. I. du Pont de Nemours & Co., Inc., employs this method, making ingots weighing over 300 lb. P. R. Mallory & Co., Inc., uses resistance furnaces.

In arc melting, sponge titanium is melted in a water-cooled copper container, using a tungsten, titanium, or some other type of electrode. Allegheny-Ludlum Steel Corp. makes ingots up to 100 lb. (and soon to 600 lb.) in a modified arc furnace.

Battelle Memorial Institute has developed a method for continuous production. Liquid magnesium is added continuously to a titanium tetrachloride atmosphere in a reaction chamber. The product con-

Mechanical Properties of Titanium

MECHANICAL PROPERTIES	IODIDE TITANIUM Annealed	SINTERED (Magnesium-reduced) Annealed	SHEATH ROLLED (Magnesium-reduced) As rolled	INDUCTION MELTED (Magnesium-reduced) Annealed	ARC MELTED (Magnesium-reduced) Annealed
Tensile strength, psi.	38,000-48,000	79,100	97,600	80,000	70,000-80,000
Yield strength (0.2% offset), psi.	20,000-24,000	64,000	75,000	72,000	58,000-68,000
Proportional limit, psi.	10,000	58,800	58,000	38,000	
Elongation in 2.0 in., %	40 (in 1.0 in.)	24.7	15.1	25	28-30
Reduction in area, %	75	- - -	- - -	55	Up to 75
Modulus of elasticity 10^6 psi.	14.0-15.5	16.8	- - -	16.0-16.5	14.5
Hardness, Brinell	73	185	- - -	228	- - -

taining 11½% solid titanium particles runs directly into an arc furnace.

Here the titanium is melted and the magnesium chloride is volatilized, condensed, and removed. The formed ingot is withdrawn from the bottom of the furnace. This process is fully covered by patent applications.

Mechanical Properties

The mechanical properties of titanium differ with the refining and melting methods. The table shows these differences, which actually are caused by the impurities in the metal—mostly nitrogen, oxygen, carbon, and tungsten.

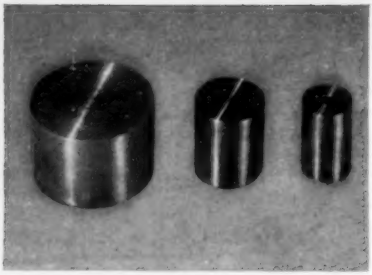
Tungsten is no problem with induction melting, but carbon pickup is from 0.25-0.80%. On the other hand, carbon pickup is no problem with arc melting, but the metal may be contaminated with tungsten from the electrode. The iodide process, although of limited commercial value, produces highly pure metal of lower strength and greater ductility.

Regardless of method, the tensile strength of unalloyed titanium in the annealed condition compares favorably with that of stainless steel and higher-strength aluminum alloys. But this is not the full story—the strength of titanium can be increased greatly by cold working or alloying.

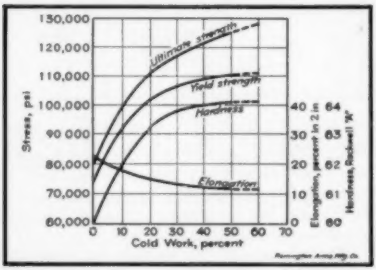
Titanium also has a high proportional strength, compared to the 25,000 psi. for fully worked austenitic stainless steels. Section for section, weight can be saved by using titanium, insofar as both tensile strength and proportional limit are concerned.

Although mechanical properties are commonly given for annealed bars, titanium alloys will be used in the as-forged rather than the annealed condition. Sheet will be used in the as-rolled annealed or cold-worked condition. Annealing may be necessary to improve sheet formability, as cold working decreases ductility while increasing strength and hardness. Cold reduction to 50% is considered a good maximum average, as over 50% gives little gain.

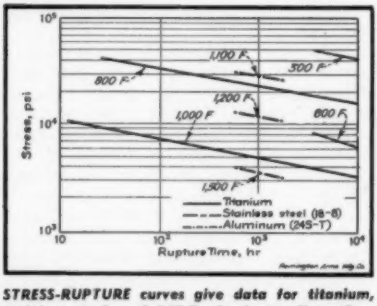
Titanium retains its strength at high temperatures—up to at least 1000°F. and



***RELATIVE TENSILE** strength of aluminum, iron, and titanium shows titanium's strength which may reach 190,000 psi. in alloyed state*



***COLD WORKING** increases hardness and strength of titanium sheet, decreases elongation; not much is gained by work hardening over 50%*



***STRESS-RUPTURE** curves give data for titanium, stainless steel, and 24S-T aluminum alloy; thus, at 800° F. and 100 hr., titanium value is 32,000*

perhaps 1200°F. in the alloyed condition. This attractive feature indicates potential uses in high-compression engines, for the skin of supersonic aircraft, and for high-temperature piping, gas-turbine compressor blades, steam-turbine reaction blading, rocket components, and equipment for the process industries.

Forged titanium bar stock with a maximum of 0.5% carbon shows virtually no creep at 600°F. under a 25,000-psi. stress, a creep rate of 0.000015% per hr. at 800°F. under 16,000 psi., and 0.00012% per hr. at 1000°F. under 2,000 psi.

Other mechanical properties include high compressive strength of 95,000 psi., impact strength (Charpy V-notch) of 1[illegible] ft.-lb., elongation at zero gage length of 90% for annealed sheet, and Rockwell C hardness of 14 for annealed metal up to 30 for 70% cold-worked stock.

Physical and Chemical Properties

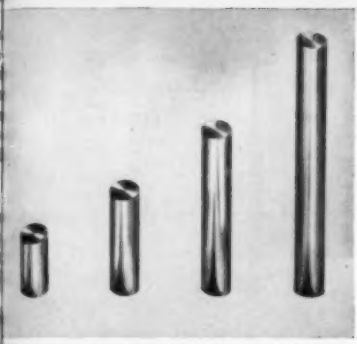
The density of pure titanium, 0.16[illegible] lb. per cu. in., is between those of aluminum and iron or stainless steel. This property immediately suggests many uses, but is not the whole answer when compressive loads are encountered.

Thick sections of light materials are more resistant to buckling loads than thin sections of denser metals. So structural parts having the same buckling resistance usually are lightest when made of the lightest material.

Titanium, therefore, will be considered for initial applications as a replacement for steel and stainless steel rather than for aluminum and magnesium. This is borne out by U. S. Navy's plans to apply titanium first for compressor blades and disks and gas-turbine engines.

Another property that indicates replacement of stainless steel in some uses is its corrosion resistance. This is said to be better than those of austenitic stainless steel, Monel, and cupro-nickel alloys and as good as that platinum in salt water.

Corrosion tests at Kure Beach, North Carolina, showed virtually no attack on



ELATIVE DENSITY of stainless steel, titanium, luminum, and magnesium is shown by these ers, each weighing 1 lb.

itanium after a 4-month immersion in ea water. Other investigations have etermined and rated its corrosion resistnce in many chemical media.

Little dimensional change was noted in cetic, chromic, lactic, nitric (98% at oom temperature), stearic, and various ombinations of sulphuric and nitric cids. Hydrochloric acid caused little or nly a moderate amount of corrosion, ccording to concentration and temperature. Sulphuric and hydrofluoric acids ere corrosive or non-corrosive, again epending on concentration and temperature.

Titanium Alloys

Titanium, like aluminum, will probably e used mostly in the alloyed condition. ensile strengths can be increased materially by alloying, from say 115,000 psi. or à H pure titanium to 160,000-190,000 si. for alloyed titanium. Ductility in ome alloys equals or exceeds that of itanium in the cold-worked state.

Titanium alloys age harden in the hot-olled condition. One alloy can be pre-ipitation hardened. Some alloys have etter oxidation resistance at elevated emperatures than does titanium.

Other advantages of alloys include excellent forgability, hot hardness, and high electrical resistivity. Most alloys need not be annealed or cold worked to obtain the desired properties.

Effects of alloying agents may be summarized briefly: Copper increases hardness mildly. Beryllium may be useful in complex alloys as a minor addition to improve working and annealing characteristics. Boron alloys have fairly good strength and ductility.

Aluminum-chromium and aluminum-iron alloys look promising; aluminum increases hardness, strength, and oxidation resistance. Silicon and carbon may be useful in small amounts.

Nitrogen is useful under 0.25%. Vanadium may be used in some ternary and quarternary alloys. It provides strength, ductility, and quench-hardenability.

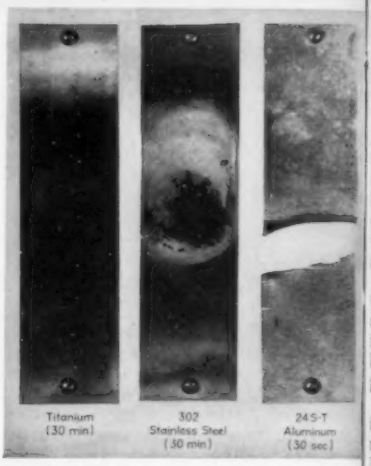
Two of the best alloying agents are chromium and molybdenum. Both increase strength, hardness, and oxidation resistance and cause no brittleness. Tungsten may be used as a minor element in complex alloys. Manganese ranks with chromium in possibility.

Iron increases strength and hardness but reduces ductility. Cobalt and nickel cause brittleness.

Here is the present alloy picture:

- Maximum alloy content of any foreseeable alloy will be 7-10%, with the average being close to 5%.
- Major alloying additions will be chromium, manganese, molybdenum, nitrogen, carbon, aluminum, and perhaps silicon, boron, and iron.
- Most promising alloys include aluminum-chromium-titanium, chromium-nitrogen-carbon-titanium, manganese-silicon-carbon-titanium, and several proprietary alloys whose compositions have not been revealed.
- Search is underway for a good heat-treatable alloy. Probably it will contain iron.
- When exhaustive tests are run on alloys now in development, some elements

***CORROSION-RESISTANCE** tests of stainless steel, 525 aluminum, and titanium show latter's superiority after 600-hr. exposure to salt water*



***FLAME RESISTANCE** of titanium under 2200° F flame at Remington Arms Research Laboratories is considerably better than type 302 or 24S-T*

may assume greater importance. But such alloys will be special purpose materials.

Fabrication Methods

Titanium and its alloys can readily be die-forged, hot-rolled, ground, welded, or swaged. Extrusion is practical. Wire drawing and machinery are more difficult.

Cold forming can be done successfully only with highly pure titanium. New fabricating methods must be developed to handle high-strength alloys or those with carbon over 0.5%.

Machinability is no better than that of austenitic stainless steel. Allegheny-Ludlum reports good success with tools made of its grade LXX high-speed steel. Carbide tools, ground to angles used for stainless steel, also are successful.

Depth of cut is $\frac{1}{32}$–$\frac{1}{16}$ in. on rough surfaces and $\frac{1}{32}$–$\frac{1}{8}$ in. on clean surfaces. Turning speed is 400 rpm. for stock up to 2-in. dia.; above 600 rpm., the cutting edge is dulled rapidly. Cutting fluids have been found to be of no help. Fine turnings present a fire hazard.

Grinding with a fine-grit, soft wheel gives a good finish. Hard wheels load and drag. Both titanium and alloys can be cut off with abrasive wheels, but band sawing is difficult, taking 10 times as long to saw as annealed stainless steel.

Tapping is difficult as the chips gall the tool. All external threads must be chased on a lathe. If threads are die-cut the piece will weld directly to the die.

Forging is done readily at 1500–1800°F. Few limitations have been discovered. One exception is that a yellow oxide forms on the surface of unalloyed titanium heated to too high a temperature. Some metallurgists regard 1950°F as the upper limit, but a heavy oxide film is certain to form at such temperatures.

Titanium is welded easily by resistance welding methods. Conditions in spot

welding, for example, can vary more widely than for stainless steel. Electric arc welding also is satisfactory, although gas shielding is necessary to prevent contamination by oxygen and nitrogen.

One problem is getting a strong welded joint between titanium and a dissimilar material. Such welds with 18-8 stainless steel, low-carbon steels, or Inconel are brittle. The problem may be solved by experiments now underway on pulsation welding, preheating, postheating, and sandwich joints.

The major trouble in extruding is the tendency of titanium to "wet" a mating surface and so weld to the die. Valves for reciprocating engines, however, have been made in the same dies used for impact extrusions of steel.

Annealed sheet titanium, 0.020–0.070 in. thick, will take a $2t$ minimum bend radius; a hard sheet will take a $4t$ radius. Brake forming is practical, but more developing is needed on drawing, spinning, die-forming, and roll-forming methods.

Casting as a production method will have limited usefulness. Titanium must be melted and cast in an inert atmosphere. No good refractory has been found. As-cast properties are not as good as those obtained by forging.

Titanium can be annealed by heating at 1300°F. for 1 hr. for forgings and bars and 15 min. for sheets. Stress relieving is done at 570° F. in air for 1 hr.

Surface hardening has not yet been fully developed. Preliminary findings indicate difficulty in preventing oxygen pickup in hot working and as a result some surface hardening occurs. The materials can be oxidized, nitrided, or hardened by other conventional surface-hardening techniques.

Where Do We Stand Today?

Designers and metallurgists in the U. S. are enthused about the possibilities of titanium. Its high cost, as stated before, has still to be overcome.

The refining and producing situation is beginning to settle down. Three companies loom as major suppliers of powder and sponge: Du Pont, National Lead, and New Jersey Zinc. Last year Du Pont supplied 90% of the material produced.

In processing the metal from sponge or sheet form, stainless-steel manufacturers will probably be the major operators. Their forging and rolling facilities are suitable for handling titanium. Besides, titanium looms as a major competitor of stainless steel, so the steel producers will be vitally interested in its development and progress.

The patent situation at present is muddled. Many companies are filing disclosures on alloys. Another confusing factor is that companies and laboratories working under contracts with government bureaus share proprietary patent rights with the bureaus involved.

What eventually may come out of the present confusion is a group of standard industry-wide alloys, such as the AISI stainless steels, plus a number of proprietary alloys. But such standardization is still years away.—Prod Eng, Nov, p129

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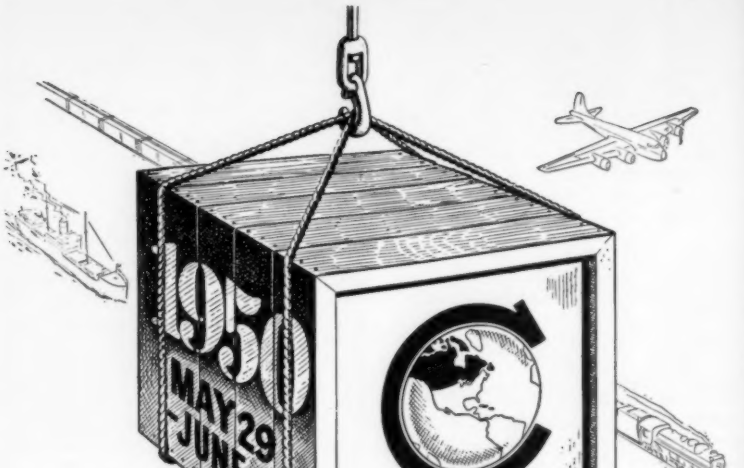

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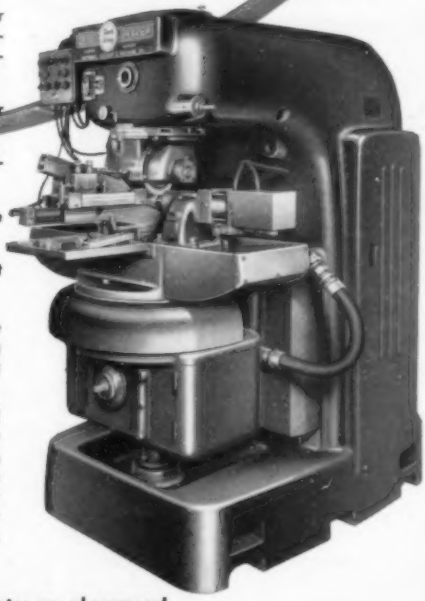

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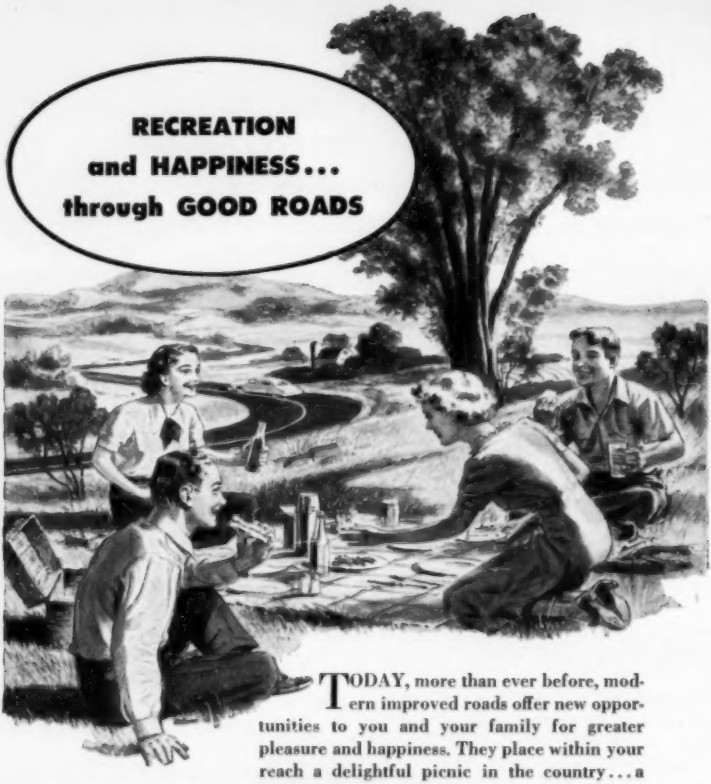

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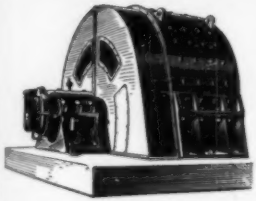

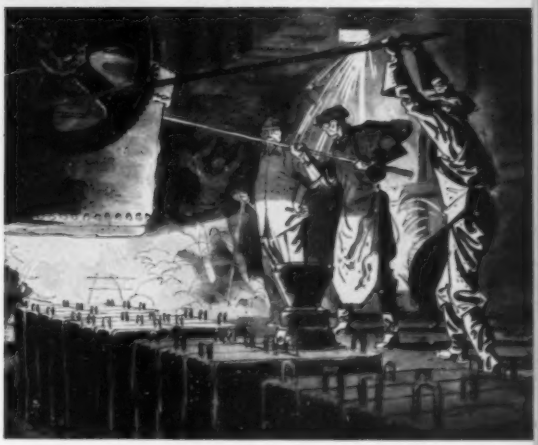

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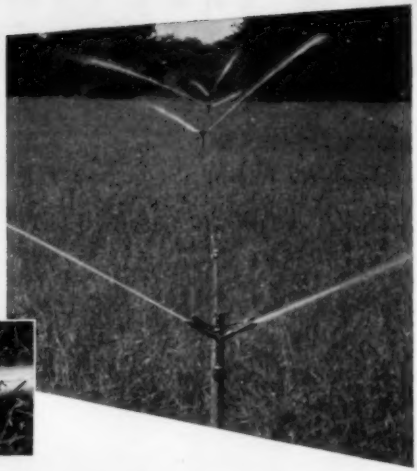

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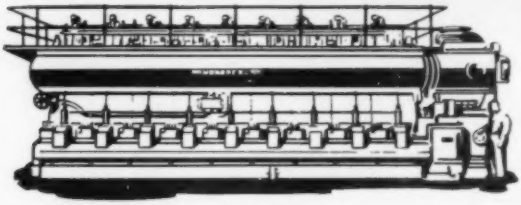

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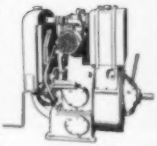

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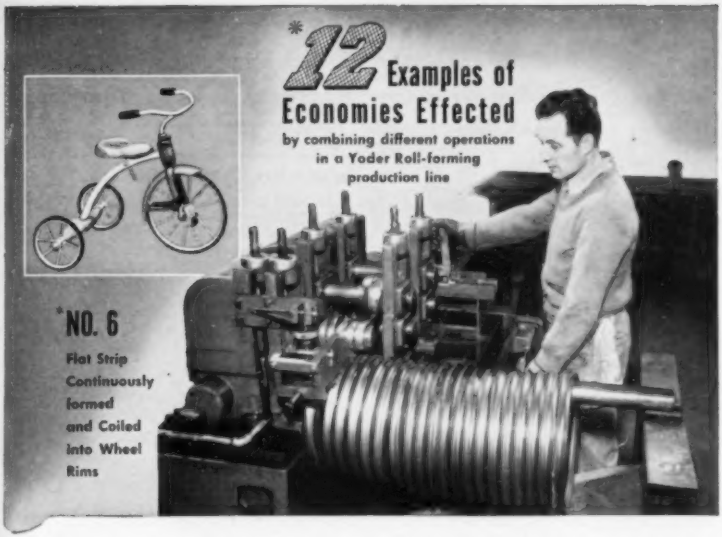

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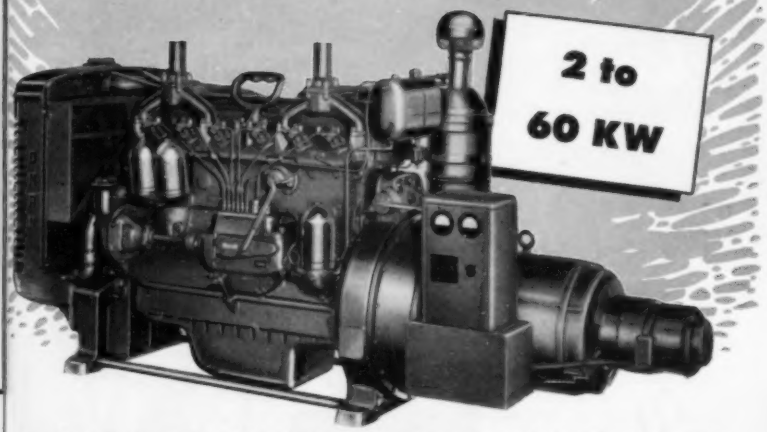

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